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The ASB

BULLETIN

Volume 17, Number 1

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The science building at Florida Southern College, Lakeland, is crowned by a planetarium at one end. It is one of seven buildings designed by Frank Lloyd Wright for the FSC campus, comprising the world's largest complex of his work.

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CONTENTS

Shelta Cave Project Successful in Purchase of Cave 2

About the Lakeland Meeting 3

Mountain Lake Biological Station Announces 1970 Summer Courses 6

Contact Load in Biology Departments in the Southeast 7

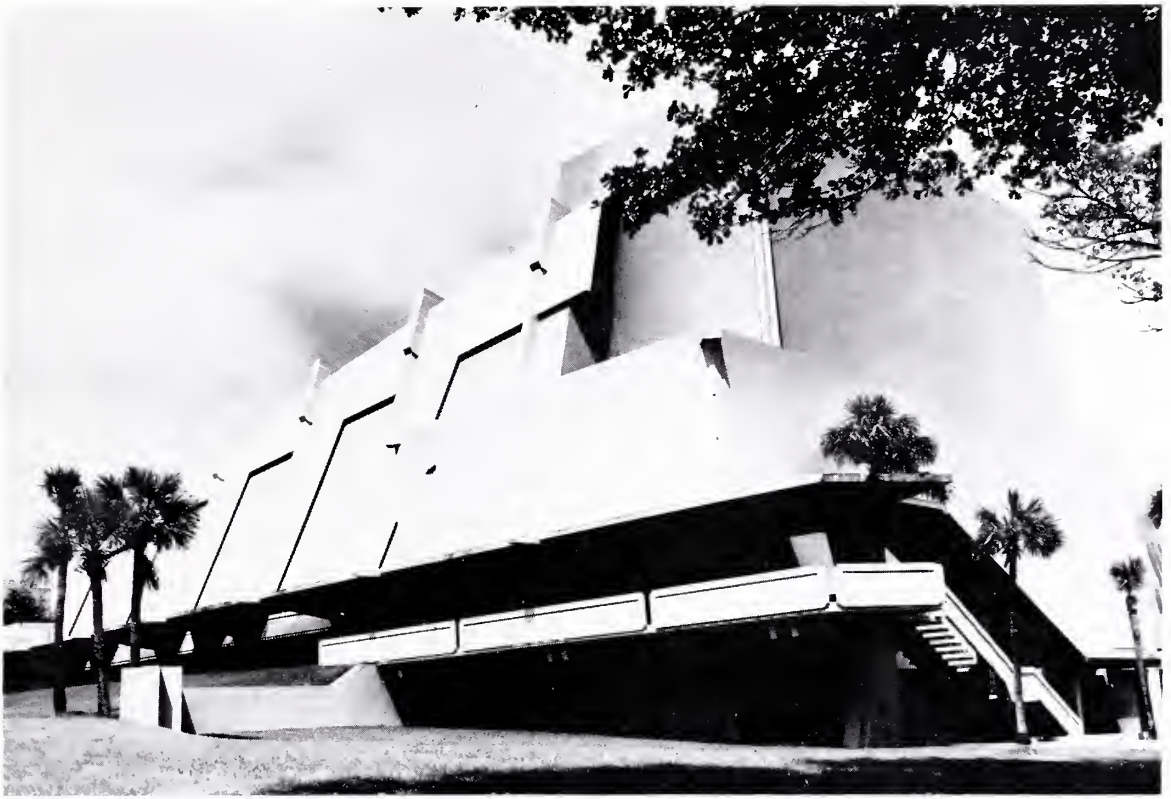
Positions and Materials Wanted 12

Shelta Cave Project Successful
in Purchase of Cave

John E. Cooper, Chairman of the Shelta Cave Project Fund-raising Committee of the National Speleological Society, has announced that the Society's campaign to purchase biologically unique Shelta Cave in Huntsville, Alabama, has met with complete success. The Society's goal was to raise \$10,000 to buy land containing the cave entrances. The total amount of contributions was in excess of \$12,000. Shelta Cave is now a nature preserve and natural underground laboratory, owned by the NSS and protected by a sturdy gate. Although no general collecting of the fauna is allowed, and no actual research facilities are available, research projects in the cave are being encouraged by the Society. An intensive, long-term ecological study of the aquatic community is in progress, and studies of the bat population are planned.

Further information concerning research possibilities in Shelta Cave may be obtained from Dr. William B. White, Chairman, Research Advisory Committee, National Speleological Society, 201 Engineering Science Building, University Park, Pennsylvania 16802.

The National Speleological Society thanks all those members of the Association of Southeastern Biologists who contributed to the Shelta Cave Fund and helped save this invaluable cave.



The Branscomb Memorial Auditorium at Florida Southern College, Lakeland, seats 1812 persons and has the latest equipment for lectures, theatrics, concerts, and motion pictures. In addition, the building includes three large classrooms. The gift of Florida Methodists, it is named for the late Bishop John Branscomb. Its architecture harmonizes with the nearby Frank Lloyd Wright buildings.

ABOUT THE LAKELAND MEETING

The Association of Southeastern Biologists will hold its 31st annual meeting April 2-4, 1970, at Florida Southern College, Lakeland, Florida. Registration will be at Branscomb Memorial Auditorium on the west side of the campus. Parking is located on the west and the north sides of the campus and on adjacent streets. The Thursday evening program will be at 7:30 in the Auditorium. After this program, the smoker will be held in the exhibit area and on the adjacent patio. Plant physiology paper sessions will be held on Thursday and Friday, and papers in other sections will be held Friday morning and afternoon. Busi-

ness meetings of the various groups meeting with the A.S.B. and of the Association will be held on Friday. The Friday evening banquet and presentation of awards, followed by the retiring President's address, will be held in the college cafeteria Lake Room.

Registration

Branscomb Auditorium Lobby
 2:00 P.M. to 9:00 P.M. Wednesday
 8:00 A.M. to 7:00 P.M. Thursday
 10:00 A.M. to 11:00 P.M. Thursday
 8:00 A.M. to 5:00 P.M. Friday
 Fee — \$2.00

Exhibits

Branscomb Auditorium, Green and Book Rooms

2:00 P.M. to 11:00 P.M. Thursday

8:00 A.M. to 5:30 P.M. Friday

Paper Sessions

Branscomb Auditorium, Rooms A, B, C.

Polk County Science Building.

Buckner Building.

Pfeiffer Chapel.

Other scheduled events

Breakfasts and luncheons may be scheduled in the Collegiate and Presidential dining rooms of the college cafeteria, or at local restaurants if reserved in advance.

7:30 A.M. Saturday. Breakfast, Southern Section, American Society of Plant Physiologists. Collegiate Room.

GENERAL INFORMATION

Lakeland is the headquarters for the mid-Florida citrus and phosphate industries, and also serves the cattle ranches of the area. Polk County produces 25 per cent of U.S. citrus (more than all of California) and 72 per cent of the world's phosphate. The city is also the spring training home of the Detroit Tigers. Lakeland gets its name from the 13 lakes within the corporate limits, including beautiful Lake Hollingsworth which borders the Florida Southern College campus.

Florida Southern, the state's oldest private college, was founded by Methodists in 1885. It is co-educational with 1400 resident students. The college is internationally known as the world's largest complex of Frank Lloyd Wright architecture.

Attractions in the Lakeland vicinity include Cypress Gardens at Winter Haven, the Bok Tower Gardens at Lake Wales, and Busch Gardens and animal collection in nearby Tampa.

Weather in early April is likely to range in temperature from 60 to 80 F, and showers may occur.

Travel to Lakeland

Suggested automobile routes to Lakeland are:

From the northwest: U.S. 19 and U.S. 98

From the north: I. 75 from Atlanta to Blanton, Florida (near Dade City) and U.S. 98

From the northeast: I. 95 to the Daytona Beach interchange and I. 4.

Greyhound Bus Lines and Seaboard Coast Line Railroad enter the city. There is limousine service from Tampa International Airport (\$4.50 one way) and Orlando Airport (\$8.50 one way) the Drane Field, the Lakeland Airport, takes private planes and shuttles up to two-engine or jet size.

Parking

The closest parking to the meetings is on campus off Johnson Street to the west of the campus. Parking will also be available in the McDonald Street lot to the north, and on streets adjacent to the campus.

Dining Facilities

Meals will be available in the college cafeteria as follows:

Breakfast	Lunch	Dinner
7:15-8:45 A.M.	11:30-1:30 P.M.	4:30-6:30 P.M.
\$0.75	\$1.10	\$1.50

There is a snack bar under the cafeteria. Many restaurants, with varied cuisine, are available, especially on Florida Avenue and Memorial Boulevard. Information will be available at the registration desk.

Field Trips

Local field trips are being planned by affiliated societies. If interest is expressed in more extensive field trips in South Florida on April 5, the following trips will be planned:

1. *Island Biogeography*. A visit to Lignumvitae Key and small mangrove islands of the type studied by Simberloff and Wilson, *Ecology* 50:2: 267-278, 278-296, 296-314. The night of April 4 would be spent at the University of Miami's Pigeon Key Field Laboratory, so that some marine exploration would be possible.

2. *Ecological Issues in South Florida*. A visit to the controversial jetport in Big Cypress Swamp and the Turkey Point nuclear power plant on south Biscayne Bay. The night of April 4 would be spent in Miami.

3. *Everglades National Park.* A trip into the wilderness area of Whitewater Bay and visits to Royal Palm and Mahogany Hammocks. The night of April 4 would be spent at Flamingo in the Park.

These trips would be sponsored by the University of Miami's Center for Urban Studies and Biology Department. Faculty, graduate students, Park Service personnel, and members of the student Environment Group would serve as guides. Transportation would be arranged from Miami to field sites. A mailing in January will announce details, including costs and reservation forms.

Placement Service

A registry of potential employers and employees will be available and a bulletin board service will be maintained. Interview schedules will be arranged in a private room near the exhibit area.

Accommodations

Housing is being handled by the Lakeland Convention Bureau of the Chamber of Commerce. The motels listed below have reserved rooms for this meeting until March 20, 1970. *Since the tourist season may not be entirely over during the meeting dates, it is strongly recommended that reservations be made early.* Motels require one night's deposit to assure guaranteed reservations. Fill out the blank mailed in November, or the coupon below, enclose your check made out to 'Housing Bureau,' and return to:

Housing Bureau

ASB

Box 3538

Lakeland, Florida 33802

Rates listed do not include Florida Sales Tax of 4%.

MOTEL	Miles from college	1 person Single Bed	2 persons Double Bed	2 persons Twin Beds	# Rooms reserved
Bradley Motel Highway 92 East	3	\$7.00		\$9.00	7
Holiday Inn South 3405 S. Florida Ave.	1	\$14-16		\$18-20	50
Howard Johnson's Motor Lodge I. 4 and U.S. 98 North	3	\$14.00		\$16-18	36
Imperial 400 740 E. Main St.	0.5			\$14.00	25
Ramada Inn 601 E. Memorial Blvd.	1			\$14-15	60
Siesta Motel Highway 92 West	3	\$10.00	\$11.00	\$13.00	13
Sunset Motel Highway 92 West	3	\$9-10		\$12.00	10
Tiger Villa Motel Highway 92 West	3	\$9.00	\$12.00	\$14.00	9
Travelodge 244 N. Florida Ave.	0.5		\$12.00		10

Other motels which have made no guaranteed reservations, but which would honor early reservations include:

Holiday Inn North
910 E. Memorial Blvd.

Prestler's Motel
2435 Highway 92 West

Motel Lakeland
1224 E. Memorial Blvd.

White Swan Motor Lodge
1136 E. Rose St.

Rates would be comparable to those listed above. (See Housing form)

NAMES AND ADDRESSES OF ALL PERSONS FOR WHOM RESERVATIONS ARE MADE:

Arrival date Time Departure date

MOTEL CHOICE:

NUMBER OF ROOMS:

First 1 person — 1 bed

Second 2 persons — 1 bed

Third 2 persons — 2 beds

Local Arrangements Committee

Margaret L. Gilbert, Co-chairman

M. Sher Ali

Charles F. Eickenberg

Howard M. Field

John B. Funderburg, Jr., Co-chairman

Raymond Lyle

Thomas Mack

Ann Truitt

Southeastern Society of Parasitologists Representative: Richard E. Bradley, Sr., University of Florida, Gainesville

American Society of Plant Physiologists, Southern Section Representative: Page W. Morgan, Texas A & M University, College Station

Mountain Lake Biological Station Announces 1970 Summer Courses

The University of Virginia has announced the program of graduate biological courses to be offered this summer at the Mountain Lake Biological Station in southwestern Virginia. They are as follows:

First Term — June 10 through July 14

Algology: Dr. Francis R. Trainor, University of Connecticut

Herpetology: Dr. Harry G. M. Jopson, Bridge-water College

Invertebrate Physiology: Dr. Fred A. Diehl, University of Virginia

Taxonomy of Seed Plants: Dr. A. Murray Evans, University of Tennessee

Second Term — July 16 through August 18

Animal Behavior: Dr. Richard B. Hemmes, Duke University

Ecological Genetics: Dr. David A. West, Virginia Polytechnic Institute

Mammalogy: Dr. Charles O. Handley, Jr., U.S. National Museum

Pteridology: Dr. Warren H. Wagner, Jr., University of Michigan

(Continued on page 12)

Contact Load in Biology Departments in the Southeast

A preliminary report of the Committee on Standards in the Biological Sciences of the Association of Southeastern Biologists.

DAVID J. COTTER, *Georgia College*

During the fall quarter of 1968 a questionnaire was mailed to 100 departmental chairmen listed in the A.I.B.S. Directory of Bioscience Departments. The selection of the departments was on the basis of being located in geographic confines of the southeast and having a student enrollment of less than 10,000. The smaller schools were emphasized in this original survey for two reasons: (1) it was felt that the more critical need for contact load analysis resided with the smaller schools and (2) the larger universities with established graduate programs with teaching assistantships would tend to confound the data and perhaps result in a question of the validity of the data.

The questionnaire sought to establish the current status of the profession throughout the southeast, emphasizing the teaching assignments of the personnel in these departments. Results of this survey were presented to the Executive Committee of the A.S.B. at the Memphis State University meeting. The members of the executive committee felt that this information was worthwhile and the project should be expanded to cover more aspects of the functions of a biology department. President John Carpenter, University of Kentucky, appointed a committee at the Executive Committee meeting in Atlanta on October 18 to conduct an evaluation of many facets of the biology programs throughout the southeast. Appointed to this *ad hoc* committee were Franklin Flint (chairman), John H. Mullahy, and David J. Cotter.

The *ad hoc* committee was charged with collecting pertinent data on the biology departments in the southeast in order to have an accurate assessment of the present status of the profession and the possible adoptions of minimal standards which would have regional implications. The A.I.B.S. standards published in 1963 were national rather

than regional in scope and presented standards rather than an analysis of the actual conditions. Although the standards were valuable in the past, they are now outdated and fail to have as great an implication as a set of standards with a regional base.

The specific value of the study would be the documentation of our present status, so that we will be aware of the condition of other schools throughout the southeast. It could serve as an impetus for a regional conference such as those sponsored by C.U.E.B.S. on the undergraduate curriculum or the recent section of the A.I.B.S. meeting in Vermont which dealt with the administration problems faced by departmental chairmen throughout the country.

Results of Initial Survey

In order to crystallize the objectives of the broad questionnaire to be initiated in the next few months the results of the original survey are presented in Table 1. It should be noted that this first survey was very limited in scope and concentrated on faculty contact load. The return of sixty percent of the questionnaires is extraordinarily high for such questionnaires and indicates an interest in such a survey. All respondents were furnished with a copy of the results.

After the first few completed questionnaires were received some of the drawbacks and ambiguities of the questionnaire became immediately apparent. The chief discrepancies resided in the tabulation of the number of students and failure to distinguish between contact and credit hours. Now that some of the problems have become apparent it is hoped that an expanded questionnaire with detailed directions can be devised to eliminate both confusion and omissions of vital considerations.

TABLE 1. — Summary of data from first questionnaire.

	Student enrollment	Students/ biology faculty	Number of faculty	Number of biology faculty	Percent of faculty in biology	Maximum contact hours	Minimum contact hours	Average contact hours
1	9000	(375)	450	24	(5.3)	12	3	8-9
2	8500	(370)	420	23	(5.5)	18	3	12
3	7602	(475)	337	16	(4.7)	17	14	15-16
4	7300	(562)	700	13	(1.9)			16
5	5600	(467)		12		10-12	6-8	8-10
6	5000	(417)		12		20	15	17
7	4800	(240)	325	20	(6.1)	15	11	13
8	4615	(288)	255	16	(6.3)	15	8	14
9	4500	(450)	138	10	(7.2)	22	11	18.1
10	4304	(430)	250	10	(4.0)	16	10	14
11	3384	(677)	84	5	(5.9)	15	15	15
12	3300	(471)	169	6½	(3.8)	15	10	12.9
13	3200	(267)	122	12	(9.8)	19	14	16.5
14	3184	(398)	300	8	(2.7)	15	6	9.12
15	3100	(221)	360	14	(3.9)	12	3	9
16	3054	(255)	122	12	(9.8)	17	15	16
17	2800	(467)	155	6	(3.7)	14-17	12	15
18	2646	(441)		6		21	17	18
19	2500	(500)	130	5	(3.8)	22	22	22
20	2335	(333)	105	7	(3.0)	15	4	14
21	2280	(760)	79	3	(1.3)	15	12	14
22	2150	(430)	89	5	(6.7)	14	12	13-14
23	2000	(400)	110	5	(4.6)	23	12	16-18
24	1986	(397)	81	5	(6.2)	20	14	18
25	1900	(173)	128	11	(8.6)	13	11	12
26	1856	(371)	93	5	(5.4)	12	7	10
27	1821	(364)	82	5	(6.1)	20	15	16½
28	1783	(255)	98	7	(7.1)			21.3
29	1665	(333)	75	5	(6.7)	19	17	17
30	1600	(320)	90	5	(5.5)	18	14	16
31	1579	(315)	91	5	(5.5)	16	10	15
32	1390	(348)		4		21/sem	9-10	15-16.5
33	1378	(367)	50	2½	(5.2)	21	14	17
34	1300	(325)		4		15	10	12
35	1255	(209)	86	6	(7.0)	14	9	12
36	1208	(402)	64	3	(4.7)	20	17	18
37	1205	(301)	64	4	(6.3)			
38	1186	(169)		7		14	9	12
39	1100	(220)	81	5	(6.2)			12
40	1021		44			20	13	16
41	1013	(253)		4		18	12	15
42	1000	(250)	45+	4	(8.9)	21	21	21
43	950	(190)	88	5	(5.7)	13	7	11
44	950	(237)	61	4	(6.6)	18	14	16
45	950	(237)	59	4	(6.8)	15	11	13
46	860		70	4½	(6.1)	14	13	13.5
47	850	(283)	60	3	(5.0)	17	12	15-16
48	848	(91)	110	9	(8.2)	16	12	16
49	836	(209)	42	4	(9.5)	19	12	15
50	819	(163)	52	5	(9.6)	15	12	12
51	732	(243)	56	3	(5.4)	30	26	28
52	717	(239)	58	3	(5.2)	17	15	16
53	675	(225)	54	3	(5.5)		10	20
54	631	(126)	56	5	(8.9)	13	7	9.6
55	625	(208)	44	3	(6.8)	17	6	14-15
56				8		15	7	14
57				4		20	15	18
58				6		9	8	9
59				4		15	15	15

Some of the confounding factors which obviously affected certain aspects of the data are:

- 1) State versus private support
- 2) Graduate versus solely undergraduate preparation
- 3) The presence of part time personnel
- 4) The relative orientation of the school (i.e. liberal arts, pre-professional orientation, demands of different departments for service courses as nursing, pharmacy, agriculture etc.).

For this reason a statistical analysis was not attempted since some of the basic factors were not taken into consideration. It is hoped that the new questionnaire, with its greater complexity and larger sample will allow a more complete analysis of the data requested. One of the reasons that this material is published is to elicit your response of suggestions for the format of the questionnaire. Any suggestions or additional refinements or cautions will be greatly appreciated by the *ad hoc* committee.

The data are presented in this way to retain anonymity, since permission to publish these data by individual schools was not requested when it was solicited.

The primary purpose of this preliminary report is to focus attention on the more comprehensive and broader based report to be approached through a later questionnaire. If enough interest is engendered it could perhaps lead to a session for departmental chairmen at the A.S.B. such as was initiated at the most recent A.I.B.S. meeting in Vermont in August, 1969.

In order to point out some of the values of the initial survey a comparison of a couple of departments would illustrate some of the values of the report. Comparison of schools 9 and 10 or 23 and 24 show approximately the same general student enrollment, the same number of faculty in the biology departments, yet there is a marked difference in the total number of faculty at each institution. Should school 10 or 23 be entitled to a proportionate increase in biology faculty? A comparison of school 51 and 52 indicates striking similarity in these two institutions yet the contact load for the two schools is totally different. Why is there such a striking disparity? The department in school 51 should analyze its program

to see if some teaching relief could be provided by modifying its present teaching assignments. The most obvious technique in reducing teaching load is to increase the size of the freshman class and meet multiple laboratory sections for lecture. Yet increasing a teacher's efficiency (making him available to more students at one time) may not increase his effectiveness (the ability to impart knowledge and influence students). The objectives of the program would have to be evaluated on the home campus but these published figures might cause this department to question its function or enable it to justify additional personnel. Spatial limitations may also limit the capability of a department to offer large freshmen or service courses.

Another way to reduce contact load is to reduce the total number of different courses in a department. A specific example of overload occurred several years ago in which one department with a staff of 10 offered 80 different biology courses and also conducted a graduate program at the doctoral level. If a staff member has a relatively few different assignments he can do a much better job of preparing for each course rather than continually facing a new assignment which dissipates his energies. This need for reduction in staff commitment is also a method of justifying additional staff and thereby reducing the overall contact load of the department.

The audio-tutorial approach to the laboratory is often an effective way to reduce faculty contact load. Although there are a great number of cogent reasons not to consider such an approach some departments which have tried this innovation find it highly successful, while others find it unsuccessful.

Although a regression analysis of the data was not made, there seems to be an obvious and expected pattern with an increase in the number of faculty as the enrollment increases. An apparent range is indicated by the data: 3-5 faculty for enrollment to 1150, 5-7 faculty for enrollment to 3000 and above 10 faculty for larger enrollments. There are some noteworthy exceptions: School 48 has a staff of 9 with an enrollment of 848 and school 25 has a staff of 11 for 1900 students and school 21 has only 3 for 2280 students. There

must be a tremendous range in the quality of the program at some of these institutions if size of faculty is any criterion in judging programs.

A cursory examination of the ratio between maximum and minimal contact loads reveals about an equal number of departments in three categories. In 19 schools the minimal load is from 75 to 100% of the maximal, in 19 schools the minimal load is from 60 to 75% of the maximal and in the remaining 14 the minimal ranges from 16 to 60 percent of the maximal. These figures reflect another aspect of the questionnaire not presented in Table 1 which dealt with reason for contact load reduction. Two thirds of the respondents indicated release time for administrative duties and 37 per cent allowed course reduction for research. Of the schools surveyed 30 per cent were schools with graduate programs and 44 per cent of these schools reduced loads for the teaching of graduate students. The contact load reductions for other reasons were very spotty with 15% for academic course work by faculty, 8% for services, 12% for laboratory preparation and 7% for miscellaneous reasons.

Institutions Responding to First Questionnaires

Alabama College
Albany Junior College
Alcorn A & M
Appalachian State University
Arkansas Poly. College
Armstrong State College
Asbury College
Athens College
Augusta College
Austin Peay State University
Belhaven College
Berea College
Berry College
Birmingham Southern
Carson Newman College
Cumberland College
David Lipscomb College
East Carolina University
East Tennessee State University
Florida Southern College
Fayetteville State College
Florence State University
Frostburg State
Furman University
Georgia Southern
Greensboro College
Goucher College

Kennesaw Junior College
Lambuth College
Little Rock University
Livingston University
Livingstone College
Maryland State College
Meridity College
Middle Georgia College
Mississippi College
Murray State University
Nicholls State College
North Carolina Wesleyan College
North Georgia College
Northeast Louisiana State College
Samford University
Spring Hill College
South Georgia College
Stetson University
Tennessee Tech University
Towson State College
Troy State University
Tuskegee Institute
Union College
University of the South
Wake Forest College
Western Carolina University
Western Maryland College
Winthrop College
Wofford College

The New Questionnaire

There are any number of pertinent questions that could be raised through a questionnaire sent either to departmental chairmen or to the membership at large. The committee is looking for specific suggestions on how to handle this survey and would welcome any constructive suggestions you would care to submit to them. Two questions to be resolved: (1) Should the questionnaire be sent directly to the membership or should it be sent to all departmental chairmen in the southeast? (The A.I.B.S. directory is incomplete, for example only 21 of the 50 institutions of higher education in Georgia are listed; a more complete source can be obtained from the U.S. Office of Education, Department of Health Education and Welfare); (2) should the data be identified by department? (Perhaps data could be published without identification but the information about particular schools could be obtained from the *ad hoc* committee.) Possible items for inclusion in the questionnaire include the following:

1. State support or private support.
2. Junior college, 4 year college, graduate school, Master, Doctors
3. Quarter, Semester, Trimester or 4-1-4 sequence.
4. Number of full time equivalent students enrolled in the institution in fall 1969.
5. Number of majors this year.
6. Number of bachelor's degrees granted in biology last year.
7. Number of last year's graduates now enrolled in graduate school.
8. Number of last year's graduates now enrolled in professional school.
9. Number of different courses offered each term.
10. Total student enrollment in biology courses during the current term.
11. a) Total number of undergraduate courses listed in catalogue.
b) Total number of graduate courses listed in catalogue.
12. Number of faculty members in the college or university.
13. Number of faculty members in the department, include part time as fractions.
14. For each faculty person (omit name) give the following:
a) All degrees, institutions granting degree and date
b) Number of years of professional experience
c) Rank
d) Salary for academic year
15. Are teaching loads determined by contact load (physical presence in classroom or laboratory) or credit hour load?
16. Maximum actual contact load for a faculty member this term.
17. Minimum actual contact load for a faculty member this term.
18. Average actual contact load for a faculty member this term.
19. Is the teaching load reduced or credit provided for any of the following?
a) Research
b) Administration
c) Supervision of undergraduate student research
d) Supervision of graduate student research
e) Supervision of laboratory assistants
f) Supervision and/or preparation of freshmen laboratories
g) Academic course work by faculty
h) Thesis or dissertation research or writing for those who have not completed degree requirements
20. The average number of different course preparations for a faculty member per year.
21. The average number of individual course assignments for a faculty member per year. (Count each assignment as one, including repetitions.)
22. Total number of all freshman laboratories offered each week.
23. Total number of all freshman laboratory sections meeting one lecture session.
24. Is the audio-tutorial approach used in laboratories?
25. Is one person responsible for all the freshman laboratory preparation or two in the case of two different introductory courses.
26. Average size of the freshman laboratory.
27. Average laboratory or breakage fees charged for the freshman laboratories? If no fee is collected, write none.
28. Number of hours of departmental student assistants are available this year in the department.
29. Amount of the capital outlay budget.
30. Amount of the operational supply budget.
31. Number and amount of federal contracts and grants in force during the last academic year.
32. What is the use of the overhead funds from grants in the institution?
33. Number of papers published in the department during the last academic year (publication from 9/68 to 9/69).
34. Number of abstracts produced in the department (9/68 to 9/69).
35. Listing of major equipment items costing more than \$500 (if more than 15 estimate number).
36. What is the basis for summer school assignment?
37. What is the salary basis for summer school (give percentage or the amount per course, or if salary is rank dependent and give salary for each rank).
38. Did you have to employ outside personnel for summer teaching? Yes..... No..... Number.....
39. Number of faculty teaching in the summer.
40. Number of faculty who wanted to teach but no assignments were available.
41. Do premed students major in chemistry or biology? Give relative percentage in each department.
42. Number of current periodical subscriptions.
43. Number of volumes in the library.
44. Number of books in library applying to biology (utilize the card catalogue; in the Dewey-decimal system, measure the number of inches of cards from 570 (natural science) to 610 (medical science) and multiply by number of cards per inch).
45. Amount of the library funds available for bound volume purchase.
46. Were back issues of any current periodicals purchased last year? How many?
47. Is there an effective sabbatical program operating?
48. Are there any programs of merit which you have on your campus which you believe would be of significant value on other campuses? For example, last year one university required all graduate assistants to enroll in a 3 hour non-credit course entitled supervised instruction. This simple manipulation recognized, in a form suitable for a faculty work

load report, the faculty effort which goes into the supervision of student laboratory assistants. Throughout the entire University this simple perogative generated 60 new faculty positions. Any similar techniques which aid in the functioning of a biology department would be appreciated and incorporated in the final report.

49. Does the department have a budget allotment to provide for research items required by the new additions to the department? If the answer is yes, how much is usually available?
50. Is team teaching employed? In which courses? How is this work cerdited to the faculty?

The utility of the proposed questionnaire will be to delineate the present status of many current arcas of concern for biology departments throughout the southeast, and as a documented study will provide the membership with an awareness of the conditions pertaining to other departments. Secondly it will provide a means of comparison of a person's individual department with those obtaining throughout the region and thereby give an entree into reducing contact load and improving local conditions. Thirdly, it might be possible to propose a broad set of standards for the southeast.

Although other uses may be made of the data it will provide another justification for hiring additional personnel and document the validity for requests for departmental budget increases. Other academic departments have accrediting agencies that in some cases almost dictate to local admin-

istrations not only the departments which get new additions but even designate the type of personnel to be added. No such "lobby" exists for biology departments, but a summary of the current status throughout the southeast would at least focus attention on the need. Other academic disciplines have agencies which provide evaluations, visitations, consultants, standards, recommendations, and guidelines which are utilized in justifying additional support for various departmental programs. Although limited services are provided by the Office of Biological Education/AIBS, perhaps such functions could be considered for A.S.B.

The committee earnestly requests your expression of interest and any comments that would help the validity of the data collected. We would welcome any comments.

Please write to any of the three members of the *ad hoc* committee:

Franklin F. Flint
Randolph Macon Woman's College
Lynchburg, Va. 24503

Father John H. Mullahy
Loyola University
New Orleans, Louisiana 70118

David J. Cotter
Georgia College
Milledgeville, Ga. 31061

(Continued from page 6)

A limited number of National Science Foundation scholarships are available for research and study: (1) Post-doctorate for research, stipend \$1300; (2) Pre-doctorate for supervised research, stipend \$500; and (3) Post-graduate for training in field biology, stipend \$400. Preference is given for studies concerned with the biota of the region. Application blanks for these awards may be secured from the Director, Mountain Lake Biological Station, Department of Biology, University of Virginia, Charlottesville, Virginia 22903 and must be submitted before May 1, 1970.

Biological Materials Wanted

Flowering or fruiting material and rhizome sections of cane (*Arundinaria*) for a doctoral research project on the ecological life history and floral biology of the southeastern species. Send to, or contact, *David M. DuMond, Dept. of Botany, N.C. State Univ., Raleigh, N.C. 27607.*

Position Wanted

Ecologist, Ph.D. with postdoctoral experience in mathematical and quantitative plant ecology, botanical background; seeks teaching-research position for Fall 1970, near mountains.

Inquiries sent to The Editor, ASB Bulletin, Academy of Natural Sci., Nineteenth and the Parkway, Philadelphia, Penn. 19103, will be forwarded.

7.06
The ASB

BULLETIN

Volume 17, Number 2

April 1970



Lirceus fontinalis, an aquatic isopod. This specimen is a 15-mm male from Mount Arabia, DeKalb County, Georgia. (Photo by C. E. Styron.)

***The Official Quarterly Publication of
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C. W. HART, JR.

EDITOR

DOROTHY CRANDALL BLISS

Associate Editor

JOSEPH F. FITZPATRICK, JR.,

News Editor

DAVID J. COTTER, Business Manager

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All officers are ex officio members of the executive committee.

CONTENTS

Association Affairs	14
Program of the 31st Annual Meeting of the ASB	15
Professor Lawrence C. Neal to Address ASB	27
Abstracts of Papers Presented at the 31st Annual Meeting of the ASB	28
Reverend Patrick H. Yancey — Obituary	72
Demonstration of Hardy-Weinberg Law in Large Lectures. — by D. T. Wagner	75
Books and Periodicals	77
News of Biology in the Southeast	80
Treasurer's Report — 1 Jan. 1969 - 31 Dec. 1969	83
Map of Lakeland, Florida	84

ASSOCIATION AFFAIRS

ASB Elections to be Held 3 April 1970

The following slate of candidates has been prepared by the Nominating Committee for inclusion on the 1970 ballot. The elections will be held at the annual Business Meeting on 3 April 1970.

Robert B. Short
E. Ruffin Jones
Horton H. Hobbs, Jr.
W. D. Burbanck, *Chairman*

Burton J. Bogitsh
(President)

Born on February 9, 1929, in Brooklyn, New York, Burton J. Bogitsh received his A.B. degree from New York University—University College in 1949, his M.A. degree from Baylor University in 1954 and his Ph.D. degree from the University of Virginia in 1957 under the direction of the late Bruce D. Reynolds.

From 1957 to 1963, he was a member of the faculty of Georgia Southern College, Statesboro. In 1963, he served as an assistant program director in the Division for College Teachers of the National Science Foundation in Washington, D.C.

(Continued on page 73)



Program of the 31st Annual Meeting of the Association of Southeastern Biologists

Florida Southern College, Lakeland, Florida

A joint meeting with the Southern Section of the American Society of Plant Physiologists, the Southeastern Society of Parasitologists, the Southeastern Section of the Botanical Society of America, the Southern Appalachian Botanical Club, and the Southeastern Region of Beta Beta Beta National Honorary Biological Society.

WEDNESDAY, APRIL 1.

- 2:00- 5:00 **Registration and Information:** Lobby, Branscomb Center.
7:00-11:00 (ASB, BBB registration, the Placement Bureau, Dues Payments, Tickets, and all Information concerning tours, field trips, etc. will be at this location. Phone: 813 688-8551 Ext. 235)
8:00 **Executive Committee Meeting, Southern Section of the American Society of Plant Physiologists:** Library Conference Room.

THURSDAY, APRIL 2.

- | | | | |
|--------------|--|------|--|
| 7:00-12:00 | Registration and Information: Lobby, | | |
| 1:00- 7:00 | Branscomb Center. | | |
| after | | | |
| Gen. Session | | | |
| to 11:00 | | | |
| 8:00- 5:00 | Biology Department and Southern Bio- | 7:00 | |
| | Research Institute Open to Visitors. | | |
| 8:45-10:30 | Paper Session: | 7:30 | |
| | <i>Plant Physiology.</i> Session 1. WATER | | |
| | RELATIONS. — Room A. | | |
| 10:30 | Annual Business Meeting, Southern Section | | |
| | of the American Society of Plant Physi- | | |
| | ologists. Room A. | | |
| 1:00- 7:30 | Exhibits: Green Room, Branscomb Center. | | |
| after | | | |
| Gen. Session | | | |
| to 11:00 | | | |
| 1:30 | Executive Committee Meeting, Association | | |
| | of Southeastern Biologists: Library Con- | | |
| | ference Room. | | |
| 2:00- 5:00 | Paper Sessions: | | |
| | <i>Plant Physiology.</i> Session 2. MINERAL | | |

NUTRITION AND ROOT PHYSIOLOGY. — Room A.

Plant Physiology. Session 3. **REGULATION AND REGULATORS.** — Room B.

Beta Beta Beta Dinner, Followed by Paper Sessions: College Cafeteria.

A.S.B. General Session: Auditorium, Branscomb Center.

Dr. John M. Carpenter, Presiding.

Welcoming Remarks: Dr. Charles T. Thrift, Jr., President, Florida Southern College.

Response: Dr. John M. Carpenter, President, The Association of Southeastern Biologists.

Invitational Address: Professor Lawrence C. Neal, Alden Hydraulic Laboratories, Worcester Polytechnic Institute. — *Use of Physical Models in Pollution Studies.*

Smoker: Exhibit Area and Patio, Branscomb Center.

FRIDAY, APRIL 3.

- | | | | |
|------------|---|-------------|--|
| 7:00- 5:00 | Information and Registration: Lobby, | | |
| | Branscomb Center. | | |
| 7:00 | Breakfast and Business Meeting, South- | | |
| | eastern Section of the Botanical Society | | |
| | of America, and the Southern Appala- | | |
| | chian Botanical Club: College Cafeteria, | | |
| | Collegiate Room. | | |
| 8:00 | Breakfast, Past Presidents of the Associa- | 12:00 | |
| | tion of Southeastern Biologists: College | | |
| | Cafeteria, President's Dining Room. | | |
| 8:00- 4:00 | Exhibits: Green Room, Branscomb Center. | 12:00 | |
| 8:00- 5:00 | Biology Department and Southern Bio- | | |
| | Research Institute Open to Visitors. | 1:30 (2:00) | |
| 8:30-12:00 | Paper Sessions: | - 5:00 | |
| | <i>Plant Physiology.</i> Session 4. Symposium: | | |
| | THE HORMONAL ROLES OF | | |
| | ETHYLENE. — Room A. | | |

Animal Physiology — Room C.

Ichthyology and Herpetology — Room D.

Cryptogamic Botany — Room E.

Plant Ecology — Room F.

Animal Ecology — Room G.

Plant Taxonomy — Room H.

Cytology and Cytogenetics — Room I.

Parasitology

Business Meeting, Association of South-
eastern Biologists: Auditorium, Brans-

comb Center.
Business Meeting, Beta Beta Beta —

Room F.
Paper Sessions:

Plant Physiology. Session 5. **PHOTO-**
SYNTHESIS AND CULTURE
STUDIES. — Room B.

Plant Physiology. Session 6. METABOLISM AND NUCLEIC ACIDS. — 7:30
Room A.
Animal Physiology — Room C.
Invertebrate Zoology — Room D.
Plant Anatomy and Morphology — Room E.
Plant Ecology — Room F.
Animal Ecology — Room G.
Plant Taxonomy — Room H.
Parasitology — Room I.
Ecology: Conservation and Management

— Auditorium, Branscomb Center.
A.S.B. Banquet and Presentation of Awards: College Cafeteria, Lake Room.
Association Research Prize. Sponsored by Carolina Biological Supply Company.
Meritorious Teaching Award. Sponsored by Will Scientific, Inc.
After Banquet Past President's Address: Dr. Robert Short — "Dicyemid Mesozoa" — Auditorium, Branscomb Center.

SATURDAY, APRIL 4.

- 8:00 Breakfast and Meeting, Southern Section of the American Society of Plant Physiologists.
8:30 Executive Committee Meeting, Association of Southeastern Biologists: Library Conference Room.
Field trips. Details at Registration Desk. Please sign up during registration.
See the January Bulletin for field trips to South Florida.
The following trips have been planned through the courtesy of biologists from Florida institutions:
1. Botany. Dr. Robert Long and his staff from the University of South Florida. The Kissimmee River prairies and nearby beach levels.
2. Ornithology. Dr. Glenn Woolfenden, University of South Florida. Tampa Bay area, and the collection from Busch Gardens.
3. Marine Biology. Dr. Harold Humm, University of South Florida, Marine Institute. The shallow water communities of Tampa Bay.
4. The Phosphate Mining Area of Central Florida. Dr. John Funderburg, Florida Southern College.
5. A General Trip in the Gainesville Area, depending upon the interest of those wishing to be in the field there. Dr. Pierce Brodtkorb, University of Florida. This could be the beach level scrubs, or other communities, or specific collecting for research material.
6. The Archbold Biological Station will be open to visitors, courtesy of Dr. James Layne. This station, near Lake Placid, is affiliated with the American Museum of Natural History.
Other places of interest in the vicinity include Cypress Gardens, Busch Gardens, and Mountain Lake Sanctuary (Bok Tower).
8:00 Annual Breakfast Meeting — American Society of Plant Physiologists (place to be announced, tickets must be purchased for the breakfast)
Presiding: James H. M. Henderson, Vice Chairman SS-ASPP
Breakfast Speaker: Dr. S. I. Auerbach, Chief, Radiation Ecology Section, Oak Ridge National Laboratory
Topic: The International Biological Program

SCHEDULE OF PAPER SESSIONS

THURSDAY MORNING - APRIL 2, 1970

PLANT PHYSIOLOGY

Session 1 WATER RELATIONS

Room A

Presiding: Lewis E. Dove, Western Illinois University

- | | | | |
|------|---|------|---|
| 8:45 | 1. RUTLAND, RUFUS B. AND JAMES E. PALLAS, JR. (USDA-ARS and AES, University of Georgia). Transpiration of <i>Antirrhinum majus</i> under Environmental Stress. | 9:15 | 3. JORDAN, WAYNE R. AND JOE T. RITCHIE (Texas A & M University and USDA-ARS, Temple, Texas). A Diurnal Relationship Between Leaf-water Potential and Relative Turgidity or Stem Diameter of Cotton. |
| 9:00 | 2. ALBERTE, RANDALL S. AND AUBREY W. NAYLOR (Duke University). Studies on the Relation of Humidity and Food Supply to Greening Jack Bean (<i>Canavalia ensiformis</i> (L.) DC.) Seedlings. | 9:30 | 4. PARSONS, LAWRENCE R. (Duke University). Water Relations of Developing <i>Phaseolus vulgaris</i> Seeds. |

- | | | | |
|-------|--|-------|---|
| 9:45 | Break | | |
| 10:00 | 5. MICHEL, BURLYN E. (University of Georgia).
Use of Polyethylene Glycol with Divided
Root Systems to Measure Root Resistance. | | versity of Georgia, USDA-ARS and South-
ern Piedmont Conservation Research Center,
USDA). An Explanation for the Stomatal
Response of Excised Leaves to Kinetin. |
| 10:15 | 6. PALLAS, J. E. JR. AND J. E. BOX, JR. (Uni- | 10:30 | Annual Business Meeting, ASPP |

THURSDAY AFTERNOON - APRIL 2, 1970

PLANT PHYSIOLOGY

Session 2 MINERAL NUTRITION AND ROOT PHYSIOLOGY

Room A

Presiding: M. G. Hale, Virginia Polytechnic Institute

- | | | | |
|------|--|------|---|
| 2:00 | 7. FISCUS, EDWIN L. (Auburn University).
Radial Oxygen Diffusion Rates in Plant
Roots. | | DON (Southern Illinois University). Evi-
dence for a Complex Zinc Absorption Iso-
therm in Excised Barley Roots. |
| 2:15 | 8. FARNHAM, WILLIAM F. (Duke University).
Relationship Between Water and Salt Ab-
sorption in <i>Ricinus communis</i> . | 3:15 | Break |
| 2:30 | 9. KRIEG, DANIEL R. AND H. E. JOHAM (Texas
A & M University). Organic Acid Changes
During Ion Uptake by Young Cotton Roots. | 3:30 | 12. JOHAM, H. E. AND VIOLA ROWE (Texas A
& M University). The Influence of Sodium
and Potassium on the Amino Acids of Cot-
ton Leaves. |
| 2:45 | 10. RITTENHOUSE, R. L. AND M. G. HALE (Vir-
ginia Polytechnic University). Effect of
Oxygen and Carbon Dioxide Tensions on
Release of Amino Acids and Sugars From
Peanut Roots under Gnotobiotic Conditions. | 3:45 | 13. GOSSELINK, JAMES G. (Louisiana State Uni-
versity). Growth of <i>Spartina patens</i> and
<i>Spartina alterniflora</i> as Influenced by Nitro-
gen Source and Salinity. |
| 3:00 | 11. SCHMID, WALTER E. AND RALPH E. BRAN- | 4:00 | 14. MATTEUCCI, SILVIA DIANA (Duke Univer-
sity). Kinetic Studies of Rubidium Trans-
port to the Shoots of <i>Zea mays</i> . |

PLANT PHYSIOLOGY

Session 3 REGULATION AND REGULATORS

Room B

Presiding: C. R. Benedict, Texas A & M University

- | | | | |
|------|--|------|--|
| 2:00 | 15. MORGAN, PAGE W. AND J. R. BAUR (Texas
A & M University). Involvement of Ethy-
lene in Picloram-Induced Leaf Movement
Inhibition. | | ern College). Allyl Isothiocyanate as a
Plant Growth Inhibitor. |
| 2:15 | 16. BEYER, E. M., JR. AND PAGE W. MORGAN.
(E. I. Du Pont De Nemours and Company
and Texas A & M University). A Method
for Determining the Concentration of Ethy-
lene in the Gas Phase of Plant Tissues. | 3:45 | 21. LIPE, JOHN A. AND PAGE W. MORGAN (Tex-
as A & M University). Involvement of
Ethylene in Dehiscence of Fruit. |
| 2:30 | 17. POWELL, ROBERT D. AND PAGE W. MORGAN
(Texas A & M University). The Effect of
Surrounding Tissues on the Opening of the
Hypocotyl Hook. | 4:00 | 22. PEREIRA, TARCOSIO AND H. M. VINES (Uni-
versity of Georgia). Controlled Atmos-
phere Storage of Fruit in Separate Film
Packs. |
| 2:45 | 18. KETRING, D. L. AND PAGE W. MORGAN
(Texas A & M University). Regulation of
Dormancy in Peanut Seeds. | 4:15 | 23. PAVLISTA, ALEXANDER D. AND ALAN H.
HABER (University of Tennessee and Oak
Ridge National Laboratory). Embryo Ex-
pansion Without Endosperm Rupture in
Lettuce Seed "Germination." |
| 3:00 | 19. HABER, ALAN H. AND LARRY L. TRIPLETT
(Oak Ridge National Laboratory). Testing
the Specificity of Inhibitors of DNA Syn-
thesis for Growth Studies. | 4:30 | 24. SCOTT, DAVID L. AND M. REHAN SIDDIQI
(University of South Alabama and Miami
University, Ohio). The Effect of Aqueous
Seed Extracts of <i>Abrus precatorius</i> L. on
Seed Germination and Seedling Growth. |
| 3:15 | Break | 4:45 | 25. HARRIS, DENNY O. (University of Kentucky).
Inhibitors Produced by the Colonial Flag-
ellates (Volvocaceae). |
| 3:30 | 20. WESTRA, RAYMOND N. (Georgia Southwest- | | |

FRIDAY MORNING - APRIL 3, 1970

PLANT PHYSIOLOGY

Session 4 SYMPOSIUM

ETHYLENE — A PHYTOHORMONE

Room A

Presiding: Dr. Page W. Morgan, Texas A & M University

- 9:00 LIEBERMAN, MORRIS (Pioneering Research Laboratory, USDA, Beltsville, Maryland). Pathways of Ethylene Synthesis.
JOHN GOESCHL (Institute of Life Sciences, Texas A & M University, College Station, Texas). Roles of Ethylene in Vegetative Tissue.
ELMO BEYER, JR. (Central Research Department, E. I. DuPont De Nemours and Company, Wilmington, Delaware). Ethylene as a Natural Abscission Agent.

ANIMAL PHYSIOLOGY

Room C

Presiding: Dr. C. G. Jackson, Mississippi State College for Women

- 8:30 26. LLEWELLYN, GERALD C. AND WARREN G. HANSEN (Virginia Commonwealth University and Purdue University). Toxicological Responses of Syrian Hamsters, *Mesocricetus auratus*, to Chronic Feeding of Purified Aflatoxin B₁.
10:01 33. GITTLESON, STEPHEN M., WILLIAM PAUL AND RICHARD L. HOOVER (University of Kentucky). Electrophoresis of Motile Protozoa and Algae.
8:43 27. KIMBROUGH, T. D. AND J. M. SHARPLEY (Virginia Commonwealth University). A Polygraph Technique for Determining the Relative Toxicities of Various Chemical Agents.
10:14 34. KENT, R. ELIZABETH (North Carolina State University). Isozyme Polymorphism in Southeastern Populations of the Harvester Ant, *Pogonomyrmex badius*.
8:56 28. HARPER, JENNIFER S. AND ERNEST L. HUNT (Emory University). Experimental Diabetes in the Mongolian Gerbil, *Meriones unguiculatus*.
10:27 35. JACKSON, CRAWFORD G. JR., CHARLIE M. HOLCOMB, AND MARGUERITE M. JACKSON (Mississippi State College for Women). Preliminary Studies on the Chemical Composition of Chelonians.
9:09 29. BURTON, DENNIS T. (Virginia Polytechnic Institute). Lactic and Pyruvic Acid Changes in Bluegill Sunfish (*Lepomis macrochirus* Rafinesque) During Gradual Hypoxia at Two Acclimation Temperatures (5° and 20° C.).
10:40 36. GRISWOLD, KENNETH E. (University of South Carolina). Serum Protein Patterns in Closely-related Groups of the Beachmouse.
9:22 30. VENABLE, DENNIS D. AND WILLIAM W. MILLER, III (Northeast Louisiana State College). Crystallization Patterns of Vaginal Mucus in Guinea Pigs.
10:53 37. JUBENVILLE, R. B. AND L. T. WIMER (University of South Carolina). The Effects of Synthetic Juvenile Hormone on Larval Development of the Blowfly, *Phormia regina* (Calliphoridae).
9:35 31. COOLEY, JUNE H. AND SAMUEL R. TIPTON (University of Tennessee). The Effect of Thyroxin and Cold Exposure on Brown Adipose Tissue Metabolism in Rats.
11:06 38. HOGAN, G. RICHARD (University of North Carolina at Charlotte). Studies on the Erythropoietic Effect of Corticosterone.
9:48 32. FRANDSEN, JOHN C. AND JUDITH A. COOPER (USDA Regional Parasite Research Laboratory, Auburn, Alabama). Some Properties of L-lactate Dehydrogenase from *Eimeria stiedae*. (Protozoa: Coccidia).
11:19 39. SOKOLOFF, BORIS AND GEORGE G. ROBINSON (Southern Bio-Research Institute, Florida Southern College). Certain Aspects of the Biological Activity of Serotonin.

ICHTHYOLOGY AND HERPETOLOGY

Room D

Presiding: Dr. J. Cairns, Jr., Virginia Polytechnic Institute

- | | |
|--|--|
| <p>8:30 40. FARRELL, MICHAEL P. (Savannah River Ecology Laboratory). Effect of Temperature and Photoperiod Acclimations on the Water Economy of <i>Hyla crucifer</i> (Hylidae).</p> <p>8:43 41. TREVARTHEN, ROSEMARY (Western Carolina University). The Life History of the Salamander <i>Eurycea bislineata wilderae</i> in Western North Carolina (Plethodontidae).</p> <p>8:56 42. BRUCE, RICHARD C. (Western Carolina University). The Life History of <i>Stereochilus marginatus</i> (Plethodontidae).</p> <p>9:09 43. CHILCUTT, ANN MCBRIDE AND CRAWFORD G. JACKSON, JR. (Mississippi State College for Women). Osteological Studies of the Musk Turtles (Chelydridae: <i>Sternotherus</i>).</p> <p>9:22 44. DAVIS, JOHN D. AND CRAWFORD G. JACKSON, JR. (Mississippi State College). Studies of the Courtship Patterns of Turtles.</p> <p>9:35 45. GIBBONS, J. WHITEFIELD (Savannah River Ecology Laboratory). Evolutionary Considerations of Reproductive Parameters in Turtles.</p> | <p>9:48 46. SMITH, GARY C. (Savannah River Ecology Laboratory). Effects of Size, Injury, and Starvation on the Shedding Frequency of <i>Elaphe guttata</i> and <i>Heterodon platyrhinos</i> (Colubridae).</p> <p>10:01 47. LEE, DAVID S. AND JOHN FUNDERBURG (Natural History Society of Maryland and Florida Southern College). The Geographic and Ecological Distribution of the Florida Scrub Lizard, <i>Sceloporus woodi</i> Stejneger.</p> <p>10:14 48. FUNDERBURG, JOHN B. AND DAVID S. LEE (Florida Southern College and National History Society of Maryland). Reproduction and Growth of the Endemic Florida Scrub Lizard, <i>Sceloporus woodi</i>, Stejneger.</p> <p>10:27 49. SPARKS, RICHARD E., WILLIAM T. WALIER, JOHN CAIRNS, JR., AND ALAN G. HEATH (Virginia Polytechnic Institute). Diurnal Variation in the Behavior and Physiology of Bluegills.</p> <p>10:40 50. OUTTEN, L. M. (Mars Hill College). Studies of Fishes in Western North Carolina (Cyprinidae).</p> |
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CRYPTOGAMIC BOTANY

Room E

Presiding: Dr. Lafayette Frederick, Atlanta University

- | | |
|---|---|
| <p>8:30 51. ALI, M. SHER, YOSHIHARU TODA AND BORIS SOKOLOFF (Southern Bio-Research Institute, Florida Southern College). A New Antibiotic Isolated From the Everglades Soil.</p> <p>8:43 52. WOLF, F. T. AND D. DWIDJOSEPUTRO (Vanderbilt University). Microbiological Studies of Indonesian Fermented Foodstuffs.</p> <p>8:56 53. COLE, GARRY T. AND HENRY C. ALDRICH (University of Florida). Developmental and Ultrastructural Studies of Microfungi.</p> <p>9:09 54. SEN, SHUKDEB AND LAFAYETTE FREDERICK (Atlanta University). Studies on Chemically Induced Physio-morphological Changes in a Water Mold <i>Allomyces macrogynus</i>. (Blastocladiaceae).</p> <p>9:22 55. TRELAWNY, GILBERT S. (Madison College). Analysis of the Fat of <i>Phlyctochytrium</i> sp.</p> <p>9:35 56. AUSTIN, WILLIE LENA AND LAFAYETTE FREDERICK (Atlanta University). Rib Formation in Walls of Ascospores of <i>Neurospora</i> (Sordariaceae).</p> <p>9:48 57. DODD, JAMES L. (University of Tennessee). Microscopic Characters and the Taxonomy of <i>Clavicornia</i> (Basidiomycetes: Hericiaceae).</p> <p>10:01 58. LEONARD, THOMAS J. (University of Kentucky). Fruiting Body Initiation in <i>Schizophyllum commune</i> Fr.</p> | <p>10:14 59. WELDEN, A. L. (Tulane University). The Distribution of Mating-type Factors in Three Groups of Basidiocarps of <i>Podoscypha ravenelii</i> in Close Proximity.</p> <p>10:27 60. SHANNON, MICHAEL C., S. K. BALIAL AND JOHN W. HARRIS (Tennessee Technological University). Isozyme Patterns of Certain Wood-rotting Basidiomycetes (Polyporaceae).</p> <p>10:40 61. PARRONDO, R. T. (University of Florida). Airborne Algae of the Gainesville Area.</p> <p>10:53 62. COCKE, ELTON C. AND NATHANIEL WOODING JR. (Wake Forest University). Applanospore Formation and Germination in <i>Spirogyra singularis</i>.</p> <p>11:06 63. COCKE, ELTON C. AND LORRAINE B. SPENCER (Wake Forest University). A Study of <i>Vacuolaria virescens</i> Cienkowski (Chloromonadineae).</p> <p>11:19 64. THOMAS, DEMPSEY L. (Louisiana State University in New Orleans). Isozyme Taxonomy of <i>Chlorococcum</i> (Chlorococcaceae).</p> <p>11:32 65. BOWERS, FRANK D. (University of Tennessee). High Elevation Mosses of Costa Rica.</p> <p>11:45 66. SHARP, AARON J. (University of Tennessee). Different Ideas Concerning the Migration of Vascular Plants and Bryophytes from the Old World to the New.</p> |
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PLANT ECOLOGY

Room F

Presiding: Dr. Richard Stalter, Pfeiffer College

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| <p>8:30 67. DUNCAN, WILBUR H. (University of Georgia). Migration of Woody Plants into an Isolated Pine Plantation.</p> <p>8:43 68. GILLESPIE, FRANK AND ARTHUR GARRETT (University of South Alabama). The Movement of Beach Dunes on Dauphin Island, Alabama.</p> <p>8:56 69. MCCORMICK, J. FRANK AND ROBERT B. PLATT (University of North Carolina). A Half-Century of Succession in an Appalachian Forest Following the Chestnut Blight.</p> <p>9:09 70. WEAVER, GEORGE T. AND WILLIAM C. ASHBY (University of Tennessee and Southern Illinois University). Structural Changes within an Oak-Hickory Forest Remnant in Southwestern Illinois.</p> <p>9:22 71. DANIEL, CHARLES P. (Georgia College, Mill-
edgeville). Secondary Succession Follow-
ing Hay-Pasture in the Georgia Piedmont.</p> <p>9:35 72. STALTER, RICHARD (Pfeiffer College). The
Zonation of Vegetation in Southeastern Salt
Marshes.</p> <p>9:48 73. STALTER, RICHARD (Pfeiffer College). An
Ecological Study of a Rhode Island Right-
of-Way, Exeter, Rhode Island.</p> <p>10:01 74. BOSTICK, P. E. (Emory University). One-
Year Litter Breakdown on Mt. Panola,
Georgia.</p> | <p>10:14 75. PETERS, LARRY N. (Radiation Ecology Sec-
tion, Oak Ridge National Laboratory).
Distribution of Cesium-137 in a Tagged
<i>Liriodendron tulipifera</i> Forest.</p> <p>10:27 76. RITCHIE, JERRY C., J. R. MCHENRY, AND A.
C. GILL (USDA Sedimentation Laboratory,
Oxford, Mississippi). Distribution of Fall-
out Cesium-137 in the Upper 4-inches of
Soil in Relation to Vegetation Type.</p> <p>10:40 77. COLEMAN, D. C. AND G. T. COWLEY (Uni-
versity of Georgia and University of South
Carolina). Effect of Chronic, High-inten-
sity Radiation Stress on Species Composi-
tion and Respiration of Forest Litter and
Soil.</p> <p>10:53 78. COWLEY, G. T. AND D. C. COLEMAN (Uni-
versity of South Carolina and University
of Georgia). Effect of Chronic Radiation
on Forest Soil Microfungal Populations.</p> <p>11:06 79. DE SELM, H. R., CLIFFORD AMUNDSEN AND
PAUL KRUMPE (University of Tennessee).
A Program in Remote Sensing and Analysis
of Natural Environments.</p> <p>11:19 80. PLUMMER, GAYTHER L. (University of
Georgia). Thermal Emissivity from a
Grassland.</p> |
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ANIMAL ECOLOGY

Room G

Presiding: Dr. Larry N. Brown, University of South Florida

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| <p>8:30 81. BIGGS, WALTER C. JR. AND THOMAS L. QUAY
(University of North Carolina at Wilming-
ton and North Carolina State University at
Raleigh). Composite Litter Formation in
Domestic Swine, <i>Sus scrofa</i>.</p> <p>8:43 82. GOODYEAR, C. PHILLIP (Savannah River
Ecology Laboratory). Terrestrial and
Aquatic Orientation in the Starhead top-
minnow, <i>Fundulus uotii</i> (Cyprinidae).</p> <p>8:56 83. ELDERS, CHRISTOPHER A. AND JAMES D.
HOWARD (University of Georgia and the
University of Georgia Marine Institute).
Burrowing Patterns of Seven Species of
Haustoriid Amphipods.</p> <p>9:09 84. BLAIR, CHARLES B. JR. (University of Geor-
gia). Care and Maintenance of the Nine-
banded Armadillo in a Laboratory En-
vironment.</p> <p>9:22 85. KAUFMAN, DONALD W. (Savannah River
Ecology Laboratory and University of
Georgia). The Use of Assessment Lines
to Estimate Area Affected by Small Mam-
mal Removal Trapping.</p> <p>9:35 86. WINN, JOHN T. AND LARRY N. BROWN (Uni-
versity of South Florida). Habitat Prefer-
ence in an Isolated Deer Mouse Population.</p> <p>9:48 87. SMITH, MICHAEL H. (Savannah River Ecol-
ogy Laboratory and University of Georgia).
Supplementary Food and Population Dyn-
amics of the Old-Field Mouse.</p> <p>10:01 88. BOIZE, BARBARA (University of Georgia).</p> | <p>Determination of Home Range Size of
<i>Peromyscus polionomus</i> (Cricetidae).</p> <p>10:14 89. BENFIELD, ERNEST F. AND STUART E. NEFF
(Virginia Polytechnic Institute and Uni-
versity of Louisville). A Defensive Secretion
in an Aquatic Beetle (Gyrinidae).</p> <p>10:27 90. SINGH, HARPAL AND JOYCE A. LIGGINS (Ben-
nett College). Effect of Gamma Rays on
the Longevity, Reproduction and Death
Rate of <i>Rhyzopertha dominica</i> Fab. (Cole-
optera).</p> <p>10:40 91. GENTRY, JOHN B. AND DOUGLAS M. CARL-
SON (University of Georgia). The Forma-
tion and Early Development of Southern
Harvester Ant (<i>Pogonomyrmex badius</i>)
Colonies.</p> <p>10:53 92. RUTHVEN, JEANNE A. AND JOHN CAIRNS, JR.
(Virginia Polytechnic Institute). The Re-
lation Between Artificial Substrate Size and
the Number of Fresh-Water Protozoan
Species.</p> <p>11:06 93. BAMFORTH, STUART S. (Newcomb College
of Tulane University). Influence of Mois-
ture on Soil Protozoan Populations.</p> <p>11:19 94. BURBANCK, W. D. AND ROBERT G. PAYNE
(Emory University). Substratum Prefer-
ence and Population Distribution of <i>Cyathura polita</i> (Isopoda).</p> <p>11:32 95. HETRICK, L. A. (University of Florida).
Biology of the "Love-bug" <i>Plecia nearctica</i>
Hardy (Diptera: Bibionidae).</p> |
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PLANT TAXONOMY

Room H

Presiding: Dr. John D. Reynolds, Virginia Commonwealth University

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| <p>8:30 96. CHAPMAN, CAYWOOD (University of Georgia). Natural Hybridization Between <i>Senecio smallii</i> and <i>Senecio tomentosus</i> (Compositae).</p> <p>8:43 97. MORTON, GARY H. (University of Tennessee). One Rediscovered and One New Hybrid of <i>Solidago bicolor</i> L. (Asteraceae).</p> <p>8:56 98. BELL, C. RITCHIE (University of North Carolina). Fertility Patterns in <i>Gerardia</i> L. <i>sensu</i> Fernald (Scrophulariaceae).</p> <p>9:09 99. SPONGBERG, STEPHEN A. (University of North Carolina). Polyploidy and Reproductive Mechanisms in the <i>Erigeron grandiflorus</i> Complex of Western North America (Compositae).</p> <p>9:22 100. NESOM, GUY L. (Stratford College and University of North Carolina). Distribution and Ploidy Levels in <i>Erigeron flagellaris</i> Gray (Asteraceae).</p> <p>9:35 101. MUELLER, ANNA M. (University of North Carolina and North Carolina Central University). Evidence for the Existence of Tetraploid <i>Coreopsis delphinifolia</i> Lam. (Compositae).</p> <p>9:48 102. BLACK, CAROLYN B. AND W. H. MURDY (Emory University). Cytological Evidence Implicates <i>Talinum mengesii</i> in the Origin of <i>T. teretifolium</i> (Portulacaceae).</p> | <p>10:01 103. SHARMA, G. K. (University of Tennessee at Martin). Epidermal Features of Several Populations of <i>Glandularia canadensis</i> (Verbenaceae).</p> <p>10:14 104. PARKS, C. R., S. S. SANDHU AND K. R. MONTGOMERY (University of North Carolina at Chapel Hill, North Carolina Central University, and Los Angeles State and County Arboretum). The Influence of Environment on Petal Flavonoids in Four Species of <i>Gossypium</i> L. (Malvaceae).</p> <p>10:27 105. URBATSCH, LOWELL AND SAMUEL B. JONES, JR. (University of Georgia). Biosystematic Study of the Species Groups <i>Altissimae</i> and <i>Giganteae</i> of the Genus <i>Vernonia</i> (Compositae).</p> <p>10:40 106. JONES, SAMUEL B. JR. (University of Georgia). Scanning Electron Microscopy in Systematics: <i>Vernonia</i> pollen (Compositae).</p> <p>10:53 107. REYNOLDS, JOHN D. (Virginia Commonwealth University). Microsporogenesis and Microgametogenesis In <i>Vernonia cinerea</i> Less. (Compositae).</p> <p>11:06 108. REYNOLDS, JOHN D. (Virginia Commonwealth University). Megasporogenesis and Megagametogenesis In <i>Vernonia cinerea</i> Less. (Compositae).</p> |
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CYTOLOGY AND CYTOGENETICS

Room I

Presiding: Dr. Luther S. Williams, Atlanta University

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| <p>8:30 109. ALLEN, JOHN AND LUTHER S. WILLIAMS (Atlanta University). Correlation of Sonification Time with Extraction and Yield of Transfer RNA from <i>Escherichia coli</i>.</p> <p>8:43 110. WASHINGTON, HAROLD L. AND LUTHER S. WILLIAMS (Atlanta University). Repression of Leucyl-tRNA Synthetase of <i>Escherichia coli</i>.</p> <p>8:56 111. WILLIAMS, ARTHUR L. AND LUTHER S. WILLIAMS (Atlanta University). Characterization of an Arginyl-tRNA Synthetase Mutant of <i>Escherichia coli</i>.</p> <p>9:09 112. HINTON, DOROTHY M. AND LUTHER S. WILLIAMS (Atlanta University). Study of Arginyl-tRNA Synthetase in a Wild Type and Mutant Strains of <i>Escherichia coli</i>.</p> <p>9:22 113. PAYTON, CECIL W. AND LUTHER S. WILLIAMS (Atlanta University). The Mechanism of Canavanine Resistance in <i>Escherichia coli</i>.</p> | <p>9:35 114. REAMS, WILLIE M. JR. (University of Richmond and Medical College of Virginia). A Genetic Approach to the Problem of Langerhans Cells: (Spotting genotypes in mice).</p> <p>9:48 115. APPLEGATE, A., M. MCBEE, AND D. RAFFERTY (Western Kentucky University). The Origin of Rough Endoplasmic Reticulum in Very Young Oocytes of the Gastropod, <i>Ilyanassa obsoleta</i>.</p> <p>10:01 116. BURBANCK, MADELINE P. AND W. D. BURBANCK (Emory University). Recognition of Stages in Spermatogenesis in <i>Cyathura polita</i> (Crustacea, Isopoda).</p> |
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PARASITOLOGY

Room I

Presiding: Dr. Elon E. Byrd, University of Georgia

- 10:27 117. BOGITSH, BURTON J. (Vanderbilt University). Cytochemistry of the Mehlis' Gland of *Haematoleochus medioplexus* (Trematoda: Digenea).
- 10:40 118. ALLEN, W. R. III AND REINARD HARKEMA (North Carolina State University). Histochemical Studies on the Enzymes of a Strigeoid Trematode.
- 10:53 119. LUNDQUIST, LEONARD E. (Lander College). A Histochemical Study on the Intestinal Epithelium of *Rhabdias ranae* Walton.
- 11:06 120. GARRITY, RICHARD DAVID (Florida State University). Preliminary Studies on the Function and Fine Structure of the Intestinal Epithelium of *Cotylaspis insignis* Leidy, 1857 (Trematoda: Aspidobothria).
- 11:19 121. BRICKLER, DOROTHY A. (Florida State University). The Nature and Function of the Marginal Organs of *Cotylaspis insignis* Leidy, 1857 (Trematoda: Aspidobothria).
- 11:32 122. CLARKE, JANET R. (Florida State University). Morphological Studies on the Miracidium of *Schistosoma mansoni* (Trematoda: Schistosomatidae).
- 11:45 123. WEINER, DAVID J. AND RICHARD E. BRADLEY (University of Florida). A New Modification of Knott's Method for Counting Microfilariae.

FRIDAY AFTERNOON - APRIL 3, 1970

PLANT PHYSIOLOGY

Session 5 PHOTOSYNTHESIS AND CULTURE STUDIES

Room B

Presiding: Hans Gaffron, Florida State University

- 2:00 124. SCHICK, HANS-JÜRGEN (Florida State University). Nitrogen Fixation by *Rhodospirillum rubrum* Measured Manometrically in Correlation with Malate Metabolism.
- 2:15 125. STUART, T. S. (Florida State University). Light-dependent Hydrogen Production by Photosystem I of *Scenedesmus*.
- 2:30 126. HARNISCHFEGGER, GÖTZ (Florida State University). Correlation Between Structure and Function of Isolated Chloroplasts.
- 2:45 127. SMOLEN, MICHAEL (University of Tennessee). The Induction of Delayed Fluorescence in *Chlorella pyrenoidosa* by a Short Intense Light Flash.
- 3:00 128. PIKE, JOHN D. AND RAYMOND W. HOLTON (University of Tennessee). Respiration Studies with a Dark-grown Blue-green Alga.
- 3:15 Break
- 3:30 129. CARROLL, JACK W., JERRY THOMAS, CHARLES DUNAWAY AND JOSEPH C. O'KELLEY. (University of Alabama). A New Method For Synchronizing Some Algal Species That Divide Preferentially in Darkness. (*Protophlon botryoides* and other species).
- 3:45 130. BHALLA, PRITHVI R. AND PRITAM S. SABHARWAL (University of Kentucky). Investigations on the Effect of Tobacco Smoke Components on Plant Cells in Tissue Culture.
- 4:00 131. BOULWARE, MARGARET A. AND N. DWIGHT CAMPER (Clemson University). Effects of Some Chemicals on the Stability of Isolated Protoplasts.
- 4:15 132. PIETERSE, ARNOLD H., PRITHVI R. BHALLA AND PRITAM S. SABHARWAL (University of Kentucky). Control of Gibbosity in *Lemna gibba* G³ by Ethylenediamine-di-o-hydroxyphenylacetic Acid (EDDHA).
- 4:30 133. CAPONETTI, JAMES D., GERALDINE HALL AND ROBERT A. FARMER, JR. (University of Tennessee and the Tennessee Valley Authority). *In vitro* Growth of Black Cherry (*Prunus serotina*) Callus: effects of medium, environment and genotype (Rosaceae).

PLANT PHYSIOLOGY

Session 6 METABOLISM AND NUCLEIC ACIDS

Room A

Presiding: Aubrey W. Naylor, Duke University

- 1:45 134. ELEY, J. H. (University of Kentucky). Glycolate Metabolism in *Chlorella pyrenoidosa*.
- 2:00 135. REGER, BONNIE J., J. L. EPLER AND W. EDGAR BARNETT (Oak Ridge National Laboratory). Induction of Aminoacyl RNA Synthetases in *Englena*.
- 2:15 136. STONE, B. P., C. N. WHITTY AND J. H. CHERRY (Austin Peay State University and Purdue University). Effects of Ethionine, Ionizing Radiation and 5-Fluorouracil on Development of Invertase and Methylation of RNA in Sugar Beet Disks.
- 2:30 137. SCHWARZ, OTTO J. AND ROGER C. FITES. (Oak Ridge National Laboratory and North Carolina State University). The Appearance of Pyrimidine Nucleoside and Deoxynucleoside Kinase Activities in Peanut Axes.

- 2:45 138. HENDERSON, J. H. M. AND ELAINE YAT LAAN TENG (Tuskegee Institute). The Enzymatic Nature of IAA Oxidase from the *Avena* Coleoptile.
- 3:00 139. WISE, BYRON H. AND MARTIN MORRISON (Memphis State University and St. Jude Children's Research Hospital, Memphis). Peroxidases in the Cotton Plant (*Gossypium herbaceum* L.)
- 3:15 Break
- 3:30 140. NAYLOR, GERALD W. (Carson-Newman College). Preliminary Studies of Lipid Classes From Several Pollen Species By Thin-layer Chromatography.
- 3:45 141. BOGGESE, SAMUEL F. AND AUBREY W. NAYLOR (Duke University). A Study of Ornithine Transcarbamylase from *Nostoc muscorum*.
- 4:00 142. HOUSLEY, THOMAS AND DONALD B. FISHER (University of Georgia). Retention of Water-soluble Compounds During Freeze Substitution.
- 4:15 143. CAMPER, N. DWIGHT (Clemson University). Sorption of Six *s*-Triazines to Proteins.
- 4:30 144. YOW, MELVIN AND BYRON H. WISE (Memphis State University). Pasteur Effect in the Corn Seedling (*Zea mays* L.).
- 4:45 145. CHAPMAN, WILLIAM E. AND JOHN W. HARRIS (Tennessee Technological University). Distribution of E₁, E₄ and Fast Esterases in Various Tissues of Mature Maize Plants.

ANIMAL PHYSIOLOGY

Room C

Presiding: Dr. W. W. Norris, Jr., Northeast Louisiana State College

- 2:00 146. COHEN, JERRY ALAN AND ERNEST L. HUNT (Emory University). Preliminary Studies of Neurosecretion in *Limax*.
- 2:13 147. DAVIS, ELAINE J. AND ROY HUNTER, JR. (Atlanta University). Studies on the Induction of Chondrogenic Activity in Notochordal Cells from *Rana clamitans* Larvae.
- 2:26 148. EDWARDS, KIAH III AND LOUIS E. CROSSLLEY (Wiley College). Some Effects of Acidic, Alkaline, and Neutral Salt Solutions on the Notochordal Sheath of *Rana clamitans* Larvae. (Ranidae).
- 2:39 149. TURNER, JAMES E. AND SAMUEL R. TIPTON (University of Tennessee). The Thyroid Gland and Tail Regeneration in the Lizard *Anolis carolinensis* (Iguanidae).
- 2:52 150. BARSACCHI, GIUSEPPINA AND A. A. HUMPHRIES, JR. (Emory University). Progesterone-induced *in vitro* Maturation in Oocytes of the Newt, *Notophthalmus viridescens*.
- 3:05 151. FINLAY, MARY-FLEMING AND WALLACE D. DAWSON (University of South Carolina). Comparative Estrogen Effects on the Uterus of *Peromyscus* (White-footed mice) (Cricetidae).
- 3:18 152. DENT, JAMES (University of Virginia). Survival and Function of Autoplastic, Homoplastic and Xenoplastic Pituitary Grafts in the Newt (Salamandridae).
- 3:31 153. HYDE, CORNELIA T. (Georgia Southern College). Observations on Growth and Regeneration of the Compound Eye of *Periplaneta americana* (Blattidae).
- 3:44 154. WILLIAMS, JIMMY E. AND P. S. RUSHTON (Memphis State University). The Appearance of Sensory Retinal Folds in the Chick Embryo After X-Irradiation.
- 3:57 155. HYMEL, JEROME R. AND WILLIAM W. NORRIS, JR. (Northeast Louisiana State College). A Numerical Evaluation of the Cells of the Corpora Lutea in Pseudopregnant and Pseudopregnant Bilaterally Enucleated Hamsters.
- 4:10 156. BURNS, PATSY HALL AND W. W. NORRIS, JR. (Northeast Louisiana State College). The Effect of Timed Bilateral Orbital Enucleation on the Duration of Pseudopregnancy in Hamsters (Cricetidae).
- 4:23 157. BENNETT, SARA N., DONALD A. OLEWINE AND LINDA J. JORDAN (Georgia Southern College). Histological Comparison of Deciduous Formation in Pseudopregnant Rats with Intrauterine and Intracervical Sutures.

INVERTEBRATE ZOOLOGY

Room D

Presiding: Dr. Ronald Schmoller, University of Tennessee

- 2:00 158. DUNDEE, D. S. (Louisiana State University). Invertebrate Zoology Today: what is it and what are the trends?
- 2:13 159. STYRON, CLARENCE E. (St. Andrews Presbyterian College). Taxonomy of Two Populations of an Aquatic Isopod, *Lirceus fontinalis* Raf. (Asellidae).
- 2:26 160. FLEMING, LAWRENCE E. (Virginia Polytechnic Institute). A New Epigeic Species of Isopod Crustacean from Virginia.
- 2:39 161. CARPENTER, JERRY H. (University of Kentucky). Taxonomic and Ecological Studies of Cave Planarians (Planariidae).
- 2:52 162. HOFFMAN, RICHARD L. (Radford College). The Diplopod Fauna of South America.
- 3:05 163. EZELL, W. BRUCE JR. AND T. R. ADKINS, JR. (Clemson University). Methods of Collecting Tabanidae.
- 3:18 164. SCHMOLLER, RONALD (University of Tennessee). Zoogeography of North American Spiders, Especially Wolf Spiders. (Lycosidae).
- 3:31 165. TORRES, MARY SUI FISDALE AND H. L. HANSEN (Purdue University). Observations on the Mating of the Spider, *Tetragnatha elongata* Walck.

- 3:44 166. LUTZ, PAUL E. (University of North Carolina at Greensboro). Effects of Temperature and Photoperiod on Seasonal Development of *Tetragoneuria cynosura* Larvae. (Odonata).
- 3:57 167. KNIGHT, LUTHER A., JR. AND THOMAS M. SMITH (University of Mississippi and University of Mississippi School of Medicine). Preliminary Studies on Lipid Class and Fatty Acid Composition in the Colonial Rotifer *Simantherina semibullata* Thorpe.

PLANT ANATOMY AND MORPHOLOGY

Room E

Presiding: Dr. J. M. Herr, Jr., University of South Carolina

- 2:00 168. VASIL, I. K. AND H. C. ALDRICH (University of Florida). Pollen Development in *Podocarpus macrophyllus* D. Don. (Gymnospermae). I.
- 2:13 169. ALDRICH, H. C. AND I. K. VASIL (University of Florida). Pollen Development in *Podocarpus macrophyllus* D. Don. (Gymnospermae). II.
- 2:26 170. REMBERT, DAVID H. AND J. M. HERR, JR. (University of South Carolina). Ovule and Sporogenous Tissue Development in *Cassia abbreviata* Oliver var. *granitica* by the Application of Traditional Techniques. (Caesalpinaceae).
- 2:39 171. HERR, J. M., JR. AND DAVID H. REMBERT, JR. (University of South Carolina). Ovule and Sporogenous Tissue Development in *Cassia abbreviata* Oliver var. *granitica* by the Application of a New Clearing-Squash Technique. (Caesalpinaceae).
- 2:52 172. SMITH, BRUCE B. AND J. M. HERR, JR. (University of South Carolina). Megagametogenesis and Early Embryogeny in *Ammannia coccinea* Rothb. (Lythraceae).
- 3:05 173. SHEALY, HARRY E. AND J. M. HERR, JR. (University of South Carolina). Carpeloid Stamens in *Rubus trivialis* Michx. (Rosaceae).
- 3:18 174. LIPSCOMB, HARRIETT A. (Georgia College at Milledgeville). The Vegetative Anatomy of *Phryma leptostachya* L. (Phrymaceae).
- 3:31 175. WILBUR, FRANK H. (University of Virginia). The Effects of Cell Association on Growth and Differentiation of *Pelargonium hortorum* Cells *in vitro*.
- 3:44 176. WHITSON, MONA M. AND WILLIAM W. ELAM (Mississippi State University and Mississippi State College for Women). Histochemical Comparison of Dormant and Elongating Shoot Apices of *Pinus taeda* L. (Pinaceae).
- 3:57 177. KNAUFT, ROBERT AND H. C. ALDRICH (University of Florida). The Ultrastructure of Mycorrhizal Protocorm Development in *Epidendrum conopseum* (Orchidaceae).
- 4:10 178. HOFFMAN, GEORGE R. (University of Tennessee). Effects of Thymidine and Thymidine Analogues on 5-Fluorodeoxyuridine-induced Mitotic Inhibition.
- 4:23 179. STOVALL, MARMAN H. AND PRISCILLA S. RUSHTON (Memphis State University). Preliminary Results of ATP Pretreatment on Radiation-induced Chromatid Abberations in *Tradescantia*.

PLANT ECOLOGY

Room F

Presiding: Dr. Jerry M. Baskin, University of Kentucky

- 2:00 180. VEAL, FRED M. AND EDWIN G. BECK (Tucker High School and University of Georgia). The Biology of the Tar Spot Gall Caused by *Asteromyia carbonifera* (Cecidomyiidae).
- 2:13 181. ROGERS, HOLLIS J. (University of North Carolina at Greensboro). *Drosera rotundifolia* L. on Cascades Creek, Danbury, North Carolina.
- 2:26 182. HESS, LLOYD W. AND F. GLENN GOFF (University of Missouri). Comparative Nutrient Composition of Forest Trees in Central Missouri.
- 2:39 183. HESS, LLOYD W. AND JOHN J. ROCHOW (University of Missouri). Turnover Rates of the Major Elements in the Tree Leaf Litter of Central Missouri Forests.
- 2:52 184. BURT, KATHLEEN M. AND JOHN F. UTLEY (Duke University and University of South Florida). Translocation of Calcium-45 in *Tillandsia balbisiana* Schult. (Bromeliaceae).
- 3:05 185. HARRIS, W. FRANKLIN (Radiation Ecology Section, Oak Ridge National Laboratory). Effects of Acute Doses of Fast Neutron Radiation on Leaf Area Development and Net Photosynthesis of *Liriodendron tulipifera* L. and *Acer saccharinum* L. Seedlings.
- 3:18 186. STALTER, RICHARD (Pfeiffer College). Transplantation of Salt Marsh Vegetation, Georgetown, South Carolina.
- 3:31 187. WINFIELD, CAROLINE T. AND EDWARD E. C. CLEBSCH (Medical College of Virginia and University of Tennessee). The Ecology of *Pieris floribunda* Benth. and Hooker (Ericaceae) in a Pine-Heath Community in the Great Smoky Mountains.
- 3:44 188. BOYD, CLAUDE E. AND LLOYD W. HESS (Savannah River Ecology Lab). Factors Influencing Shoot Production and Mineral Nutrient Levels in *Typha latifolia*.
- 3:57 189. BASKIN, CAROL C. AND JERRY M. BASKIN (University of Kentucky). Some Aspects of the Autecology of *Agave virginica* (Amaryllidaceae).
- 4:10 190. BASKIN, JERRY M. AND CAROL C. BASKIN (University of Kentucky). Germination

- Regulating Mechanisms in *Leavenworthia* spp. (Cruciferae).
- 4:23 191. SENECA, ERNEST D. (North Carolina State University). Seedling Response of Two Dune Grasses, *Ammophila brevifolulata*

- Fern. and *Uniola paniculata* L. (Poaceae) to Various Photoperiods and Thermoperiods.
- 4:36 192. WILLIAMS, ROBERT DALE (Western Kentucky University). Populational Differences in Seed Weight of *Acer negundo* L.

ANIMAL ECOLOGY

Room G

Presiding: Dr. James N. Layne, Archbold Biological Station,
American Museum of Natural History

- 2:00 193. CALLAHAN, JAMES T. (University of Georgia). Bioenergetics of *Hyphantria cunea* (Drury) (Lepidoptera: Arctiidae).
- 2:13 194. RAULERSON, LYNN (University of Georgia). The Ecological Energetics of a Laboratory Population of *Chironomus tentans* (Chironomidae).
- 2:26 195. REYNOLDS, JOHN W. (University of Tennessee). The Relationship of the Earthworm (Lumbricidae and Megascolecidae) Distribution and Biomass to Soil Type in Forest and Grassland Habitats at Oak Ridge National Laboratory.
- 2:39 196. BEUMER, RONALD J. (University of Arkansas and University of Georgia). Effects of Temperature and Season on Weight of Interscapular Brown Fat of Harvest and Deer Mice (Cricetidae).
- 2:52 197. FINK, ALAN (University of Georgia). Effect of Hypoxia and Varying Ambient Temperature on the Metabolism of the Old-Field Mouse.
- 3:05 198. BLEM, CHARLES R. (Virginia Commonwealth University). Resistance to Chronic Low Temperature in the House Sparrow, *Passer domesticus* (Ploceidae).
- 3:18 199. JINKS, WILLARD L. (Marshall University). The Effects of Fluctuating Temperatures on the Reproductive Potential of *Drosophila affinis*. (Drosophilidae).
- 3:31 200. BROWN, LARRY N. (University of South Florida). Reproductive Biology of the Southeastern Pocket Gopher, *Geomys pinetis* (Geomysidae).
- 3:44 201. COOLEY, J. L. (University of Tennessee and Oak Ridge National Laboratory). The Effects of Chronic Gamma Irradiation on Snails.
- 3:57 202. HARVEY, R. S. (Savannah River Ecology Laboratory). Temperature Effects on the Sorption of Radionuclides by Midges (Tendipedidae).

PLANT TAXONOMY

Room H

Presiding: Dr. Robert W. Long, University of South Florida

- 2:00 203. PERRY, JAMES D. (University of North Carolina at Asheville). Biosystematic Studies in *Sabatia* (Gentianaceae).
- 2:13 204. STEVENSON, JOHN C. (University of North Carolina). Evolutionary Patterns in the *Spiranthes cernua* Complex (Orchidaceae).
- 2:26 205. MEIJER, WILLEM (University of Kentucky). On the Genus *Axinandra* Thwaites (Melastomataceae) and the Taxonomic Position of Rhizophoraceae.
- 2:39 206. DRAPALIK, DONALD J. (Georgia Southern College). The Taxonomic Status of *Matelea* Aublet in the Southeastern United States. (Asclepiadaceae).
- 2:52 207. WATSON, J. RAY (Mississippi State University). Aquifoliaceae of Mississippi.
- 3:05 208. TAYLOR, FRED G. JR. (Oak Ridge National Laboratory). Phenological Records of Vascular Plants at Oak Ridge, Tennessee.
- 3:18 209. DUMOND, DAVID M. (North Carolina State University). Vascular Floristic Study of a Southeastern Blue Ridge Escarpment Gorge.
- 3:31 210. WILCOX, WILLIAM H. AND E. T. BROWNE, JR. (Memphis State University). The Vascular Flora of Crittenden County, Arkansas.
- 3:44 211. LONG, ROBERT W. AND OLGA IAKELA (University of South Florida). Flora of Tropical Florida.
- 3:57 211a. GIBSON, JOAN R. (Smithsonian Institution). Flora of Alder Run Bog, Tucker Co., West Virginia. (Abstract at end of abstract section—not in alphabetical order.)
- 4:10 212. RADFORD, ALBERT E. (University of North Carolina). Progress Report on the Southeastern Flora.

PARASITOLOGY

Room I

Presiding: Dr. Richard E. Bradley, Sr., University of Florida

- 2:00 213. THE UNIVERSITY OF SOUTH CAROLINA AND SOUTH CAROLINA EDUCATIONAL TELEVISION NETWORK "Who Lives With You?" 16 mm. movie introduced by Felix H. Lauter.
- 2:13 214. RADHAKRISHNAN, C. V. AND R. E. BRADLEY (University of Florida). Some Helminths from Animals at Busch Gardens Zoological Park.
- 2:26 215. DISMUKES, JOHN F. AND JEANNE J. STUART (Auburn University). Some Ecto- and Endo-parasites of the Cattle Egret *Bubulcus ibis* in Alabama.
- 2:39 216. MCKEEVER, STURGIS AND HERBERT M. HENRY (Georgia Southern College). Observations on an Undescribed Species of Tapeworm (Taeniidae) Obtained from Cysticerci from the Cotton Rat, *Sigmodon hispidus*.
- 2:52 217. HENRY, HERBERT M. (Georgia Southern College). Intestinal Parasite Populations of the Cotton Rat, *Sigmodon hispidus*, as Affected by Host Physiology.
- 3:05 218. FRENCH, FRANK E., HERBERT M. HENRY AND LOUISE G. HENRY (Georgia Southern College). Quantitative Evaluation of Parasite Populations: technics for quick-freezing host and processing internal and ectoparasites (Cestoidea).
- 3:18 219. HENRY, LOUISE G. (Georgia Southern College). Population Studies of Mite Ectoparasites of the Cotton Rat, *Sigmodon hispidus*.
- 3:31 220. SPONHOLTZ, GLENN M. (Florida State University). Chemical Attractants of Schistosome Miracidia (Trematoda).
- 3:44 221. BYRD, ELON E. AND FORREST E. KELLOGG (University of Georgia). A New Acanthocephalan (Gigantorhynchidae) from the Bob-White, *Colinus virginianus floridanus* (Coues).
- 3:57 222. ROGERS, WILMER A. (Auburn University). *Epistylis* (Ciliata: Peritricha) Epizootics of Fish in the Southeastern United States.
- 4:10 223. CRIDER, STEPHEN B. AND JOHN D. PARKER (Western Kentucky University and Oklahoma State University). Seasonal Variation of a New Species of Myxosporidian Parasite (Myxobolidae) of the Bluegill Sunfish in Kentucky.
- 4:23 224. CHAPMAN, WILLIE L. JR. AND WILLIAM L. HANSON (University of Georgia). Parasitemia, Anemia, and Mortality of Neonatally Thymectomized Hamsters Infected with *Plasmodium berghei* (Plasmodiidae).
- 4:36 225. HANSON, WILLIAM L., ANITA BAYLES, AND PAUL E. THOMPSON (University of Georgia). Course of Infection of Chloroquine- and Sulfone-resistant *Plasmodium berghei* (Telospora; Eucoccidia; Plasmodiidae) in Cf-1 Albino Mice.
- 4:49 226. PRUDHON, R. A., P. A. VENDITTI, AND A. W. JONES (University of Tennessee). Effects of *Hymenolepis* (Cestoidea) on the larvae of *Tribolium confusum*: hatching of oncospheres in the beetle host.
- 5:02 227. JONES, ARTHUR W., M. R. PROFFITT, B. D. TAN, AND H. L. WARD (University of Tennessee). Prolonged Seling in *Hymenolepis microstoma* (Cestoidea).

ECOLOGY: CONSERVATION AND MANAGEMENT

Auditorium, Branscomb Center

Presiding: Dr. J. Whitfield Gibbons, Savannah River Ecology Laboratory

- 1:30 228. CRAIGHEAD, F. C. (Everglades National Park). The Impact of a Jetport.
- 1:45 229. KLUKAS, RICHARD W. (Everglades National Park). Thermal Pollution in Biscayne Bay: some implications for the future.
- 2:00 230. LANZA, GUY R., JOHN CAIRNS, JR. AND KENNETH L. DICKSON (Virginia Polytechnic Institute). The Use of a Simple Staining Technique on Diatom Populations as a Possible Indicator of Thermal Pollution.
- 2:13 231. BENNETT, DAVID H. (Savannah River Ecology Laboratory). Use of Body Temperatures in the Study of Largemouth Bass (*Micropterus salmoides*) in a Thermally Polluted Reservoir.
- 2:26 232. ABBE, GEORGE R. (Academy of Natural Sciences of Philadelphia). A Comparison of 1968 and 1969 Crab Catches on the Chesapeake Bay Adjacent to the Proposed Nuclear Power Plant at Calvert Cliffs, Maryland.
- 2:39 233. MULFORD, RICHARD A. (Academy of Natural Sciences of Philadelphia). Six Months Comparison of Plankton, Fish and Chemistry from the Chesapeake Bay Adjacent to the Proposed Nuclear Power Plant at Calvert Cliffs, Maryland.
- 2:52 234. CROSSMAN, JOHN S., JOHN CAIRNS, JR. AND KENNETH L. DICKSON (Virginia Polytechnic Institute). The Biological Recovery of the Clinch River Following a Fly-Ash Spill.
- 3:05 235. WILLIAMS, LOUIS G. (University of Alabama). What Organisms Should Be Used Now to Assess Water Quality Parameters?
- 3:18 236. DICKSON, KENNETH L., JESSE C. ARNOLD, AND JOHN CAIRNS, JR. (Virginia Polytechnic Institute). The Use of a Basket-Type Artificial Substrate Sampler for Stream Pollution Monitoring.
- 3:31 237. THOMAS, M. H. AND G. M. SIMMONS, JR. (Virginia Water Control Board and Virginia Commonwealth University). Community Structure of the Macrobenthos in Four Tributaries in the Pre-impoundment Basin of the North Anna River, Virginia.

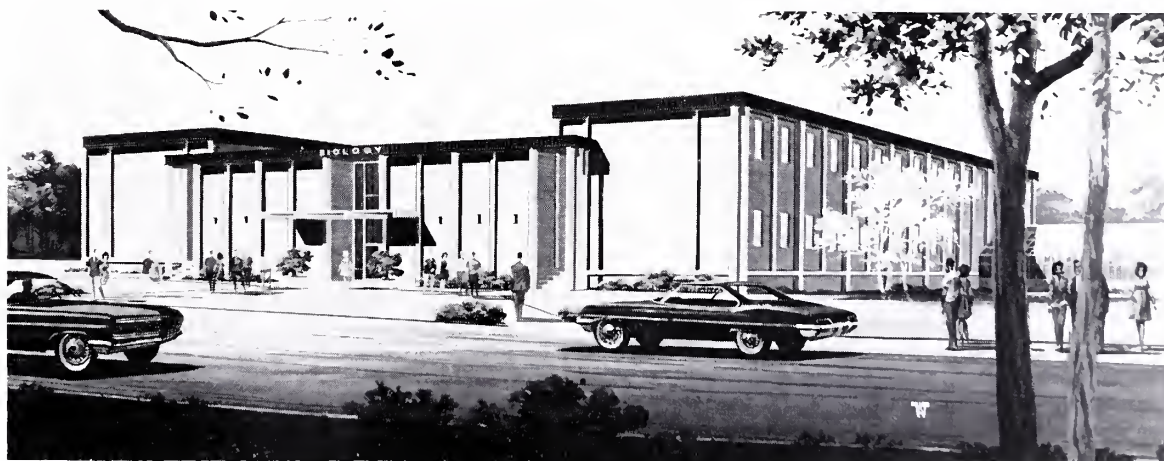
- 3:44 238. GIBSON, ROBERT A. (University of Alabama). Changes in Plankton Community Structure Associated with the Impoundment of the North River, Alabama.
- 3:57 239. HARRIS, ALVA H. AND CURT D. ROSE (Nicholls State College). Penaeid Shrimp Production in a Managed, Unfed Natural Pond in South Louisiana.
- 4:10 240. UMPHLETT, CLYDE J. AND CHU S. HUANG (University of North Carolina and Chipola Junior College). *Lagenidium culicidum* as an Agent of Biological Control of Mosquitoes.
- 4:23 241. SPENCER, DIERDRE J. AND WILLIAM K. WILLIARD (Clemson University). Bioaccumulation and Toxicity of DDT and its Metabolites in Small, Wild Mammal Populations (Cricetidae).
- 4:36 242. CHERRY, DON S. (Clemson University). Comparative Radiosensitivity in the Class Insecta.
- 4:49 243. WILLARD, WILLIAM K. (Clemson University). Comparative Radiosensitivity: a unifying concept.

Professor Lawrence C. Neal to Address ASB Thursday Evening, April 2

The Thursday evening (April 2) address, entitled "Use of Physical Models in Pollution Studies," will be given by Professor Lawrence C. Neale, Director of the Alden Hydraulic Laboratories, Worcester Polytechnic Institute, Holden, Massachusetts.

Professor Neal has been associated with the Alden Hydraulic Laboratories since 1940, and is

an authority in the use of physical models for studying rivers, dams, spillways, industrial intakes and outfalls, etc. His experience in this field is unique and of tremendous value, not only in the design of physical facilities related to industrial sites, but in the use of such models in connection with pollution studies to aid in the protection of the environment.



Georgia Southern College, Statesboro, will dedicate its new biology building (above) sometime in April, 1970. Plans are for a full day of activities including special lectures by three top professional educators in biology. The two story complex was completed the fall, 1969, and is now in operation. It is the first stage of a three million dollar science center which will include the biology building and additional areas for math and physics, and the earth sciences.

Abstracts of Papers Presented at the 31st Annual Meeting of the Association of Southeastern Biologists

The number in parenthesis at the top of each abstract refers to the number of that paper in the program.

(232)

A Comparison of 1968 and 1969 Crab Catches on the Chesapeake Bay Adjacent to the Proposed Nuclear Power Plant at Calvert Cliffs, Maryland

GEORGE R. ABBE

*Benedict Estuarine Laboratory
Academy of Natural Sciences of Philadelphia*

Two years of fishing for blue crabs, *Callinectes sapidus*, in an effort to determine what are normal crab populations has reflected the fact that tremendous changes in numbers of crabs is not abnormal. Commercial crab potting methods were used from June to November. All crabs caught were measured, sexed, and weighed. During 1968, following a poor spawning season the previous fall, crabs were scarce. In 1969, following a good spawning season in 1968, the catch per unit effort increased more than seven times. The number of market size crabs (5" and over) increased almost six times, but the percentage of markets to total crabs caught was down 15 percent. Despite the increase in numbers, the sex ratios remained nearly the same. (Research supported by The Baltimore Gas and Electric Company.)

(2)

Studies on the Relation of Humidity and Food Supply to Greening Jack Bean (*Canavalia ensiformis* (L.) DC.) Seedlings

RANDALL S. ALBERTE AND AUBREY W. NAYLOR
Duke University

The time course of greening in Jack Bean (*Canavalia ensiformis*) primary leaves was examined in six-day old etiolated seedlings in sterile culture and in control environment chambers. A consideration was made of the amounts of pigment and soluble protein. In the non-sterile study, rate of greening and protein was examined with respect to three humidity ranges, where it was shown that high humidity (90-100%) increased the rate of greening five-fold over low humidity (3-40%) with a corresponding protein increase. In the sterile culture, the beans were grown in a nutrient enriched agar and the rate of greening and protein was examined in seedlings with 0, 1 and 2 cotyledons. Seedlings with 1 cotyledon showed similar greening as those with 2 cotyledons but greater than those with 0 cotyledons; protein, however, was appreciably greater in those with 2 cotyledons. Incorporation of ^{14}C -glycine into pigment and protein was also examined.

(169)

Pollen Development in *Podocarpus macrophyllus* D. Don (Gymnospermae). II.

H. C. ALDRICH AND I. K. VASIL
University of Florida

Nuclei of haploid microspore tetrads of *Podocarpus macrophyllus* show extensive invaginations of the nuclear envelope. Evaginations of the outer nuclear membrane form vesicles as well as direct channels to the plasmalemma through the microspore cytoplasm. Such activity of the nuclear envelope and its outer membrane coincide with the deposition of certain exine layers of the microspore wall. All such activity ceases before the microspores are released from the tetrads. By this time the sexine and nexine I, comprising a part of the exine, have been formed. It is suggested that the greatly increased surface area of the nuclear envelope formed by the invaginations, the formation and blebbing off of vesicles from the outer nuclear membrane, the presence of channels connecting the nuclear envelope to the plasmalemma, and the association of chromatin-like material within the nucleus with the nuclear envelope invaginations are related to the synthesis and transport of exine precursor substances and ribonucleoproteins.

(109)

Correlation of Sonification Time With Extraction and Yield of Transfer RNA from *Escherichia Coli*

JOHN ALLEN AND LUTHER S. WILLIAMS
Atlanta University

The cells were cultured in tryptone-yeast extract-glucose medium with aeration and harvested during late-log phase growth. The cells were disrupted by sonification at varying time periods and different frequencies, and then the optical density of each sample was determined and microscopic examination were made of each preparation. The transfer RNA was then extracted with phenol and the water-layer was removed and the transfer RNA precipitated with cold ethanol and isolated, by use of routine methods. However, upon resuspension of the lipid-protein layer in buffer and extraction with phenol, it was found that transfer RNA could be removed from these layers. In addition, the lipid-protein layers were collected, dried and again extracted with phenol, and it was determined that transfer

RNA was released from these fractions. All the transfer RNA samples were usable substrates in the aminoacyl-tRNA synthetase assay systems. This data indicates that the extent of rupture of the cells by sonification was directly related to the yield of transfer RNA, and suggest that there is possible intrinsic localization of transfer RNA with membranes in vivo or selective association of RNA with membrane fractions during the extraction procedures.

(118)

Histochemical Studies on Enzyme Activity in a Strigeoid Trematode

W. R. ALLEN III AND REINARD HARKEMA
North Carolina State University

Phosphatase and dehydrogenase activity was demonstrated in *Pharyngostomoides* sp. utilizing appropriate substrates and inhibitors.

(51)

A New Antibiotic Isolated from the Everglades Soil

M. SHER ALI, YOSHIHARU TODA AND BORIS SOKOLOFF
Southern Bio-Research Institute
Florida Southern College

An unusual antibiotic was discovered from a fungus isolated from soil from the Florida Everglades. The Fermentation Division U.S.D.A. identified it as a new species belonging to a small genus, *Trichoderma*. This genus is close to *Penicillium*. Although the antibiotics of *Penicillium* are active only against certain bacteria, the *Trichoderma* antibiotic exerts pronounced activity not only against gram-positive bacteria but also against tumors and viruses. The mortality of mice infected with Hong-Kong virus is reduced 50-60 per cent. In Ehrlich mouse carcinoma and mouse melanoma, the antibiotic injected in doses of 0.2 and 0.1 mg/100 gm body weight for seven days inhibited the tumors by 40-60 per cent. It is of relatively low toxicity. Biochemical study indicates that the antibiotic contains a disulphide bridge. The method of isolation of the antibiotic is described.

(115)

The Origin of Rough Endoplasmic Reticulum in Very Young Oocytes of the Gastropod, *Ilyanassa Obsoleta*

A. APPLGATE, M. MCBEE, AND D. RAFFERTY

The prochromosomes of the premeiotic phase of oogenesis in *Ilyanassa* establish an intimate relationship with the inner membrane of the nuclear envelope. The outer membrane is studded with ribosomes and is continuous at places with the rough endoplasmic reticulum (RER) which forms an extensive system of cisternae in the cytoplasm of the germ cell. The electron microscopic evidence seems to indicate that RER is produced by delamination of the outer membrane of the nuclear envelope. Cytochemical investigations indicate that the prochromosomes contain DNA and the cytoplasm contains RNA. Autoradiography demonstrates a preponderance of synthesis of phosphorus containing compounds on the nuclear envelope.

During early leptotene, synthetic activity is evident along the nuclear envelope, on the chromosomes, and within the developing nucleolus. The RER cisternae degenerate to form vesicular RER and free ribosomes. Centrifugation of leptotene oocytes indicate that certain areas of the chromosomes are firmly attached to the nuclear envelope.

(56)

Rib Formation in Walls of Ascospores of *Neurospora*

WILLIE LENA AUSTIN AND LAFAYETTE FREDERICK
Atlanta University

The ontogeny of rib formation in walls of ascospores of three species of *Neurospora* has been studied under bright-field and phase contrast microscopy. At incipient ascus vesicle constriction, during spore delimitation, deeply pigmented granules appear in the protoplasm of the ascus. As spore delimitation progresses these granules become localized at the periphery of the protoplast. When the spore body outline is fully delineated the pigmented granules become linearly aligned at the spore surface. Within the spore body numerous, conspicuous, vacuole-like bodies develop which contain additional pigmented granules. The vacuolar bodies subsequently become positioned near the spore membrane and additional ribforming material is deposited. An increase in rib thickness results and the characteristic rib pattern of the mature ascospore is established. Ultrastructural studies are in progress in order to elucidate the fine structure of rib and wall development in ascospores of *Neurospora*.

(93)

Influence of Moisture on Soil Protozoan Populations

STUART S. BAMFORTH
Newcomb College of Tulane University

Qualitative differences between soil protozoan populations reflect the amount of moisture. About twenty species of ciliates, possessing well-developed encystment mechanisms and tolerance to a wide range of environmental conditions, constitute about 90% of the infusorian populations in typical soils. Certain globose-shaped testacea (e.g., *Plagiopyxis*) have evolved narrow apertures and are true edaphic species, but many bryophyte genera—*Nebela*, *Helcopera*, *Hyalosphenia*, *Assulina*, *Corythion*, *Centropyxis*, *Euglyphia*, and the universal *Trinema*—comprise most of the soil testacean fauna. Increased moisture content in soils allows the appearance of aquatic ciliates such as *Erontonia*, *Sathrophilus*, *Blepharisma*, and *Halteria*, and these may constitute a third of the infusoria. The first five above-named testacean genera are less frequent, and flattened aquatic Aufwuchs forms, such as *Microchlamys* and *Pxydicula*, appear. The soils of Louisiana, temperate, and polar regions are compared, and show that for testacea, type of habitat is more important than temperature.

(150)

Progesterone-induced *in vitro* Maturation in
Oocytes of the Newt, *Notophthalmus*
viridescens (Amphibia: Urodela)

GIUSEPPINA BARSACCHI AND A. A. HUMPHRIES, JR.
Emory University

In vitro maturation was inducible by progesterone in isolated ovaries or ovarian fragments only when the female had been treated previously with gonadotropin. In ovaries taken from pretreated females, exposures of oocytes to progesterone at concentrations of from 1 $\mu\text{g/ml}$ to 50 $\mu\text{g/ml}$ of Ringer's solution were effective. Continuous exposure to progesterone was less effective in inducing maturation than was limited exposure followed by Ringer's. An exposure of one hour was routinely used. The first maturation spindle usually appeared in some oocytes at about twelve hours after the initiation of progesterone treatment, but the times varied with different oocytes, even in the same ovary. In the most successful cases, nearly 100% of the largest oocytes underwent maturation, although not in synchrony. Maturation was usually not accompanied by ovulation. Incorporation of tritiated progesterone was studied by autoradiography. The sequence of certain cytological changes in chromosomes, nucleoli and general nuclear features is described. (Supported by Grant GB-12746 from the National Science Foundation and an Institutional Grant from the American Cancer Society)

(189)

Some Aspects of the Autecology of *Agave*
virginica (Amaryllidaceae)

CAROL C. BASKIN AND JERRY M. BASKIN
University of Kentucky

Agave virginica L. is a succulent, herbaceous perennial found on shallow, rocky soils throughout much of southeastern U.S. The purposes of this study were to make phenological observations on the life cycle of plants growing in the middle Tennessee cedar glades and to investigate certain phases of the life cycle under experimental conditions. The reproductive life cycle is completed by mid-October, and by late November old leaves and flowering stalks are dead. New vegetative buds, present at the caudex, are dormant through the winter but resume growth with the arrival of favorable spring temperatures. Scape elongation occurs in June and flowering begins in mid-July. Seeds germinate in early April, but these plants do not flower until several years later. Both seed germination and scape growth and flowering require a low temperature treatment. After 8 to 10 weeks of stratification seeds germinated to a high percentage at constant and alternating temperatures and in light and darkness. Ten to twelve weeks of cold were necessary to induce scape elongation and flowering. (Supported by the University of Kentucky Research Foundation.)

(190)

Germination Regulating Mechanisms in
Leavenworthia Spp. (Cruciferae)

JERRY M. BASKIN AND CAROL C. BASKIN
University of Kentucky

Leavenworthia stylosa Gray, *L. uniflora* (Michx.) Britt., and *L. torulosa* Gray are winter annuals that grow in

shallow rocky soils of middle Tennessee cedar glades. Seeds of these species are dispersed in May, but germination is delayed until September and October. This study investigates reasons for the failure of these winter annuals to germinate during the summer. At maturity, practically all of the seeds are dormant, and germination during the early part of the summer (late May and June) apparently is prevented by an internal dormancy mechanism(s). Dormancy in many of the seeds is overcome by a short period of after-ripening so that in nature seeds are non-dormant (but quiescent) during July and August. During this quiescent period, seeds will germinate at constant temperatures ranging from 10° to 20°C but not at higher constant temperatures or at alternating temperatures that occur in nature during this time. With the arrival of lower temperatures in the fall, seeds germinate as soon as moisture conditions permit. These germination regulating mechanisms are interpreted as ecological adaptations to the seasonally-arid glade habitat. (Supported by the University of Kentucky Research Foundation.)

(98)

Fertility Patterns in *Gerardia* L. *sensu* Fernald

C. RITCHIE BELL, *University of North Carolina*

In an effort to learn more about the interrelationships within and between the closely related but easily separable genera *Aureolaria*, *Tomanthera* and *Agalinis* (*Gerardia*) of the Scrophulariaceae, studies of the reproductive biology of certain species of *Aureolaria* and *Agalinis* have been carried out to determine fertility patterns prior to a more extensive experimental hybridization program. In both *Aureolaria* and *Agalinis* pollination is normally by large bees (*Bombus*); self-pollination of bagged flowers does not occur and the complete failure of seed to develop in such cases indicates that apomixis is not present. The annual species of *Aureolaria* and *Agalinis* tested are self-fertile; the perennial species of *Aureolaria* are self-sterile. Pollen viability in the species investigated is generally 85-100% and interspecific pollen size variations are not correlated with interspecific differences in style length.

(89)

A Defensive Secretion In An Aquatic Beetle
(Coleoptera: Gyrinidae)

ERNEST F. BENFIELD AND STUART E. NEFF
Virginia Polytechnic Institute and University of Louisville

The external secretion of *Dineutes discolor* is produced by a rather complex secretory apparatus located in the terminal abdominal segments. The secretory apparatus consists of paired glandular secretory lobes which drain into muscular reservoirs. A second secretory area is present in the anterior portion of the reservoir and is enclosed within a heavy cuticular capsule. The products of both secretory areas pass from the reservoirs via cuticular valves opening in a membranous area between the eighth sternite and tergite. The secretion appears to be an effective chemical defense against predators.

(231)

Use of Body Temperatures in the Study of Largemouth Bass (*Micropterus salmoides*) in a Thermally Polluted Reservoir (Teleostomi: Perciformes: Centrarchidae)

DAVID H. BENNETT

Body temperatures of largemouth bass measured immediately after collection from an artificially heated aquatic environment in South Carolina were significantly higher than fish living in waters at ambient temperatures. Although condition factors and body temperatures were extremely variable, correlation existed between them. Recording body temperatures may prove to be a valuable technique to determine vertical distributions of fishes in thermally heated environments.

(157)

Histological Comparison of Deciduomata Formation in Pseudopregnant Rats with Intrauterine and Intracervical Sutures

SARA N. BENNETT, DONALD A. OLEWINE,
AND LINDA J. JORDAN
Georgia Southern College

In an earlier study a suture placed along the entire length of the uterine lumen appeared to prevent deciduomata formation in traumatized uteri of pseudopregnant rats. Wet and dry uterine weights from such animals were markedly below that of traumatized unsutured uteri which produced very large deciduomata. Sutures placed in the cervical lumen had no effect on deciduomata formation in the corresponding uterine horn. However, placement of a suture above the utero-cervical junction so that it penetrated only the lower $\frac{1}{4}$ of the uterine lumen markedly suppressed deciduomata formation. In these animals pockets of what appeared to be decidual tissue were readily seen especially in the unsutured portions of the uterine horn. In the present investigation a histological comparison was made of deciduomata formation in pseudopregnant rats with sutured uteri, partially sutured uteri, and uteri with sutured cervixes. The findings essentially confirmed and extended our earlier observations. (Supported by a grant-in-aid from the Georgia Southern College Faculty Research Fund.)

(196)

Effects of Temperature and Season on Weight of Interscapular Brown Fat of Harvest and Deer Mice (Mammalia, Rodentia, Cricetidae)

RONALD J. BEUMER
University of Arkansas
University of Georgia
Savannah River Ecology Laboratory

Interscapular brown fat weights of laboratory-reared *Peromyscus leucopus*, *P. maniculatus* and *Reithrodontomys fulvescens* were lower in animals acclimated at 20°C than in those acclimated at either 10° or 30°. Interscapular brown fat of wild-caught animals of these three species and also of *P. boylii* was lightest in summer, heaviest in winter, and intermediate in spring and autumn, except that brown fat of *R. fulvescens* was heaviest in spring. This exception and the high interscapular brown fat weights at 30° can reasonably be

attributed to excessive lipid infiltration, since total body lipid content was exceptionally high in these cases. It is thus concluded that the true thermal trend for these species is toward increased interscapular brown fat at lower temperatures; this probably results in enhanced thermogenic capacity during colder seasons.

(16)

A Method for Determining the Concentration of Ethylene in the Gas Phase of Plant Tissues

E. M. BEYER, JR. AND P. W. MORGAN
E. I. Du Pont De Nemours & Company
Texas A & M University

Direct measurements of the internal concentration of ethylene in vegetative tissues have been limited due to the difficulties encountered in extracting gas samples from such tissues. This investigation has developed a procedure for making such measurements. The extraction method consists of applying a vacuum to a tissue completely immersed in a liquid, causing the gases within the tissue to expand, escape and collect over the liquid. The gases collected are then injected directly into a gas chromatograph for ethylene analysis. The validity and reproducibility of the method were tested by determining ethylene levels in tissues treated with ethylene. Cotton, bean, and coleus plants were fumigated with known levels of ethylene. The internal ethylene concentration of the plants tested seldom varied more than 10% from the initial internal ethylene concentration plus the fumigation concentration. These results suggest that the vacuum extraction method gives a reasonably accurate measure of the internal ethylene concentration of vegetative tissue.

(130)

Investigations on the Effect of Tobacco Smoke Components on Plant Cells in Tissue Culture

PRITHVI R. BIALLA AND PRITAM S. SABHARWAL
University of Kentucky

Studies were conducted to grow callus tissue from tobacco pith in sterile media with and without tobacco smoke components to devise a suitable bioassay for smoke carcinogens. Known amounts of the following smoke components were utilized: benzo(a)pyrene, benzo(e)pyrene, pyrene, phenol, acrolein, and nicotine. The cultures were maintained for 5 weeks at $25^{\circ} \pm 1^{\circ}$ C. Benzo(a)pyrene (10^{-7} M, 10^{-8} M) causes extensive callusing without differentiation. These observations clearly demonstrate that plant tissue cultures can be used as a promising system for a sensitive bioassay of benzo(a)pyrene. Other carcinogens have proved ineffective on this system.

(81)

Composite Litter Formation in Domestic Swine, *Sus scrofa*

WALTER C. BIGGS, JR.
University of North Carolina at Wilmington
THOMAS L. QUAY
North Carolina State University at Raleigh

Suckling behavior of swine during the first 21 days postpartum was compared in the farrowing-barn and penned-woods environments. Two types of litters were recognized: sibling and composite. Sibling litters, com-

posed only of natural littermates, occurred in both barn and woods; only litters of this type have been described in the literature. Composite litters, composed of piglets farrowed by several gilts, were found only in the relatively unrestricted penned-woods environment; 36% of the litters studied in the woods were of this type. Both types of litters developed stable suckling orders; composite litters, in contrast to sibling litters, included cross-suckler (nursed by two different gilts) and foster piglets. Behavior possible only in the woods, such as the building of nests in juxtaposition and consequent inter-litter interactions, contributed to the formation of composite litters. These litters were characterized by intense competition for teats during suckling order development; they had a higher mortality and made a lower mean gain in weight than sibling litters.

(102)

Cytological Evidence Implicates *Talinum mensesii* in the Origin of *T. teretifolium* (Portulacaceae)

CAROLYN B. BLACK AND W. H. MURDY
Emory University

Chromosome pairing at diakinesis was studied in sterile triploid and tetraploid hybrids made by crossing *Talinum teretifolium* ($2n=48$) with *T. mensesii* ($2n=24$) and with an apparent autotetraploid race of *T. mensesii* ($2n=48$) respectively. The number of figures at diakinesis (which included univalents, bivalents, and trivalents) suggests that one-half of the chromosome complement of the putative amphidiploid *T. teretifolium* is homologous with the chromosome complement of *T. mensesii*, and further suggests that previously 6, rather than 12, had been the base chromosome number in *Talinum*.

(84)

Care and Maintenance of the Nine-banded Armadillo, *Dasypus novemcinctus mexicanus*, in a Laboratory Environment (Class: Mammalia; Order: Edentata; Family: Dasypodidae.)

CHAS. B. BLAIR, JR.
School of Veterinary Medicine, Department of Anatomy
University of Georgia

The nine-banded armadillo can be maintained in the laboratory in a healthy, contented condition, accessible for investigations of all kinds. No sick or injured animals, and no intestinal or blood parasites have occurred among animals secured in Spring. Conditions of impaction, anorexia, perionychia, and integument infection pose no problem. The conditions conducive to normal quiescent existence in the laboratory involve isolation from disturbing factors of environmental origin, controlled conditions of light and temperature, and routine feeding and cleansing. Specific methods of handling, when necessary, appear to produce the least degree of excitation. Feeding and maintenance involve simple procedures which are feasible in any laboratory. When these conditions are met, only routine care of the adult animals is necessary; additional provisions must be made for care of the newborn. Sedation and tranquilization of the animals are not necessary.

(198)

Resistance to Chronic Low Temperature in the House Sparrow, *Passer domesticus*

CHARLES R. BLEM, Virginia Commonwealth University

Studies of House Sparrows, *Passer domesticus*, caught at eleven different sites extending from southern Florida to northern Manitoba indicate that size and cold tolerance increases northward in North America. That the two are interrelated is indicated in the increased resistance of larger house sparrows to long-term cold exposure under experimental conditions. Ultimate lower lethal temperature (ULLT) is linearly related to lean dry weight (LDW) within the range of weights tested. The equation describing this relationship is $ULLT = -46.5 + 4.5 LDW$, $r = +0.40$. Other indicators of body size are similarly related to cold tolerance.

(141)

A Study of Ornithine Transcarbamylase from *Nostoc muscorum*

SAMUEL F. BOGGESS AND AUBREY W. NAYLOR
Duke University

Ornithine transcarbamylase, a urea cycle enzyme which has been implicated in a little-studied pathway of bicarbonate fixation in at least two groups of algae, has been partially purified from the blue-green alga *Nostoc muscorum*. Extracts of sonically disrupted cells were fractionated by means of streptomycin, heat, salt, organic solvent and column chromatography. Full activity of the enzyme is dependent on the presence of a dialyzable, heat stable factor; such a requirement has not been observed for ornithine transcarbamylase prepared from mammalian, higher plant or bacterial sources. Studies on the regulation of enzyme activity by various metabolites, and the apparent induction of the enzyme by ammonia, carbon dioxide and other substances added to the growth medium will be discussed with respect to the operation of the bicarbonate fixing pathway mentioned above.

(117)

Cytochemistry of the Mehlis' Gland of *Haematoloechus medioplexus* (Trematoda: Digenea)

BURTON J. BOGITSH, Vanderbilt University

Acid phosphatase and glucosaminidase activity is present in the Mehlis' gland of *Haematoloechus medioplexus* as observed through the light microscope. At the level of the electron microscope, acid phosphatase activity is associated with multivesicular bodies in the MB-cells. Acid phosphatase activity is also evident in the plasma membranes of these gland cell ducts. The multivesicular bodies are believed to be derived from the Golgi areas based on results gained from the use of Golgi area markers such as osmium staining and thiamine pyrophosphatase activity. The dense bodies produced by the second type of secretory cell associated with the gland (DB-cell) reacts positively for macromolecular diglycols. On the basis of these results, it is concluded that these bodies are responsible for the mucus secreted by the glands into the ootype.

(88)

Determination of Home Range Size of *Peromyscus polionotus*

BARBARA J. BOIZE, *University of Georgia*

Home range sizes for individual *Peromyscus polionotus* were calculated using two groups, one in an enclosure and the other in an old-field. These mice were then removed to the laboratory where they were submitted to three experiments. Metabolic rate was measured over a 24-hour period with a Beckman G2 oxygen analyser. The mice were also placed in activity cages, crossed by a red light beam, and the number of interruptions of the light beam counted. The third experiment involved measuring exploratory behaviour in a specially constructed box in which a mouse could move freely for a given time interval. A correlation was found between home range size and the variation in the hourly metabolic rate.

(74)

One-Year Litter Breakdown on Mt. Panola, Georgia

P. E. BOSTICK, *Emory University*

Litter breakdown rates for each granite outcrop ecosystem type were determined for one year by means of monthly retrieval, drying, and weighing of litter enclosed in plastic-coated fiberglass screen bags. Two sets of litter bags (one retrieved monthly and one retrieved only once after twelve months) were placed in representatives of each ecosystem type on each face of the granite dome. Dry control bags were maintained in the laboratory. Litter breakdown in the outcrop ecosystems was much slower than that reported previously for forests. In general, the more advanced the seral stage, the slower the litter breakdown rate; although this may be a result of relative exposure to extreme environmental regimens. Effects of monthly manipulation of the litter bags seemed inconsequential. Mean weight retention for all eight litter types after twelve months was 89.2% for the monthly-retrieved bags and 88.6% for the non-retrieved set. Mean weight retention for laboratory controls was 96.0%.

(131)

Effects of Some Chemicals on the Stability of Isolated Protoplasts

MARGARET A. BOULWARE AND N. D. CAMPER
Clemson University

Isolation of protoplasts from immature tomato fruits and subsequent studies have been conducted by Cocking and coworkers since 1964. Tomato fruit protoplasts have been similarly prepared by degradation of cell wall material with polygalacturonase. Various stabilizing solutions have been tested; the best results were obtained with a defined salt solution. The stabilized protoplasts accumulated neutral red in the cytoplasmic regions of the cell. Neutral red uptake did not appear to be inhibited by high concentrations of potassium cyanide. Protoplasts were disrupted by treatment with various concentrations of ethanol and trichloroacetic acid. Paraquat, a bipyridylum herbicide, produced a very characteristic effect on the protoplasts which resulted in apparent membrane disruption and subsequent collapse of the cells.

(65)

High Elevation Mosses of Costa Rica

FRANK D. BOWERS, *University of Tennessee*

Mosses collected by the author and other workers from elevations above 2,500 m in Costa Rica were studied and the data obtained therefrom were integrated with that in previous literature. A total of 178 species were found with 50 reported for the first time from Costa Rica. Except for the species developed *in situ* most of the present moss flora was derived by migration of species from the south or from the north. Only 27 percent of the moss species reported occur outside South America and Central America (including Mexico and southern United States).

(188)

Factors Influencing Shoot Production and Mineral Nutrient Levels in *Typha latifolia*

CLAUDE E. BOYD AND LLOYD W. HESS
University of Georgia

Shoot standing crops for *Typha latifolia* ranged from 428 to 2,252 g dry wt/m². Standing crops were positively correlated with concentrations of dilute acid soluble phosphorus in hydrosols and dissolved phosphorus in the waters. Except for a weak correlation for dissolved calcium, additional site fertility parameters were not correlated with standing crop.

Tissue nutrient levels varied considerably, maximum values for most minerals being three or four times as great as the smallest values. Correlations between environmental levels of several nutrients and tissue concentrations were significant, but not very strong. Tissue concentrations of most nutrients were positively correlated with nitrogen content. Despite variations in tissue levels of nutrients, standing crop was the decisive factor determining quantities of nutrients per unit area of stand.

(121)

The Nature and Function of the Marginal Organs of *Cotylaspis insignis* Leidy, 1857 (Trematoda: Aspidobothria)

DOROTHY A. BRICKLER, *Florida State University*

The function of marginal organs which occur on the ventral holdfast of aspidobothrids has been considered sensory by some authors, and glandular by others. In *Cotylaspis insignis*, a symbiont on the foot and in the suprabranchial chambers of unionid freshwater mussels, there are 18 marginal organs. Each is composed of a canal which communicates with the exterior, a bulb, and gland cells, with large nuclei, which lie dorsomedially to the bulb and connect to it by filamentous ducts or tubules. Histochemical studies revealed the presence of RNA in the gland cells, and proteins, mucosubstances, and non-specific esterases in all the components of the marginal organ complex. The gland cells apparently secrete material which is stored in the bulb and released to the exterior through the canal. The enzymatic nature of the secretion suggests a role in extracorporeal digestion. No evidence for a sensory function of the marginal organs was noted.

(200)

Reproductive Biology of the Southeastern Pocket Gopher (*Geomys pinetis*)

LARRY N. BROWN, *University of South Florida, Tampa*

The breeding biology of the southeastern pocket gopher (*Geomys pinetis*) in southern Florida was studied from May, 1968 to April, 1969. The overall age composition of 505 pocket gophers was 67.1 percent adults, 25.5 percent sub-adults, and 7.3 percent juveniles. The sex ratio of males to females revealed a significant reduction in the percentage of males with age (only 40.4 percent of adults were males). Breeding took place in almost every month of the year, but peaks in female fecundity occurred in June-July of 1968 and February-March of 1969. Adult males exhibited alternating cycles of spermatogenic activity and inactivity which were not in synchrony with other males.

The mean litter size of *Geomys pinetis* based on 64 gravid females was 1.74 ± 0.51 embryos (range 1-3, mode = 2). The mean number of corpora lutea in these females was 2.10 ± 0.54 . A minimum loss of 25 percent of ova and embryos was indicated. Adult females appeared to produce two or three litters per year and postpartum pregnancies did not occur.

(42)

The Life History of *Stereochilus marginatus* (Amphibia: Caudata: Plethodontidae)

RICHARD C. BRUCE, *Western Carolina University*

The life history of *Stereochilus marginatus* was studied at Croatan National Forest in eastern North Carolina. This highly aquatic salamander is locally abundant in small ponds and drainage ditches. Mating occurs in autumn, egg-laying in winter, and hatching in late winter and early spring. The duration of the larval period varies with individual growth rates, and is either 14-17 or 26-29 months. The larvae metamorphose in late spring and summer. Males develop to maturity immediately after transformation, and breed initially at an age of either 22 or 34 months. Females remain immature for an additional year, and oviposit for the first time at either 3 or 4 years of age. There is no apparent sexual dimorphism. The sex ratio is 1:1. Life history data provide additional evidence of a close taxonomic relationship between *Stereochilus* and *Gyrinophilus* and *Pseudotriton*.

(116)

Recognition of Stages in Spermatogenesis in *Cyathura polita* (Crustacea, Isopoda)

MADELINE P. BURBANCK AND W. D. BURBANCK
Emory University

As a background for future studies on the chromosomes of widely separated populations of *Cyathura polita* and the investigation of the phenomenon of the development of a functional male from a mature female cyathuran, a study was made of spermatogenesis in cyathurans collected at Pocasset River, Massachusetts. The stages of development from spermatogonia to sperm do not occur in an orderly sequence in the two-lobed testes of *Cyathura polita*, but groups of cells within a lobe may develop at different rates. Thus a single lobe may contain resting and dividing spermatogonial cells, a

group of cells in early prophase of Meiosis I, and developing spermatids. Having previously determined the 2n number of chromosomes to be 44 in embryonic material, it was possible to recognize spermatogonial cells and successive stages of Meiosis I and II by the size of the nuclei and the amount and arrangement of the chromatin material. (Work supported by NSF Grants GB-3122 and GB-7777.)

(94)

Substratum Preference and Population Distribution of *Cyathura polita* (Crustacea, Isopoda)

W. D. BURBANCK AND ROBERT G. PAYNE
Emory University

The embayment and shore of the Caloosahatchee River between old and new U.S. 41 highways opposite Fort Myers, Florida and 17 km from the Gulf of Mexico was chosen as an ideal site for study. The predominant plant on the shore was the sedge *Scirpus robusus*, and the water in the area never exceeded one meter in depth. Cyathurans were found only in disjunct areas in substratum of more than 9 arbitrary units as determined by a "foot" of a spring balance inserted into the substratum, turned through 90°, and the amount of resistance read on the scale as the foot was withdrawn. In the compacted substratum where *Cyathura polita* did occur, distribution was random as determined by marking the location of burrows on a plastic sheet covering the substratum and by applying the "nearest neighbor" technique of Clark and Evans (1954). (Work supported by NSF Grant GB-7777.)

(156)

The Effect of Timed Bilateral Orbital Enucleation on the Duration of Pseudopregnancy in Hamsters

PATSY HALL BURNS AND W. W. NORRIS, JR.
Northeast Louisiana State College

Experiments were conducted to determine the influence of timed bilateral orbital enucleation on the duration of pseudopregnancy in golden hamsters. Twenty-six pseudopregnancies were induced in intact females, and twenty-four in enucleated females. Pseudopregnancies of 8.9 days average duration for normal pseudopregnant controls, 8.3 days for animals enucleated six days after sterile mating, 7.6 days for animals enucleated four days after sterile mating, 8.2 days for animals enucleated eight days before sterile mating, 5.7 days for animals enucleated 16-18 days before sterile mating, and 5.8 days for animals enucleated 23-29 days before sterile mating were determined. Nine additional females enucleated 32 days before attempted sterile mating would not mate. These findings suggest that the activated pineal is an important functional part of the neuro-endocrine mechanism regulating the gonads during pseudopregnancy.

(184)

Uptake and Translocation of Calcium-45 in *Tillandsia balbisiana* Schult. (Liliatae: Bromeliales)

KATHLEEN M. BURT, *Duke University*
JOHN F. UTLEY, *University of South Florida*

Adaptation of the Bromeliaceae to epiphytic habitats may have resulted from evolution of enhanced foliar

uptake and translocation of mineral nutrients. Since certain foliarly absorbed minerals are immobile, epiphytic bromeliads would have a nutritional disadvantage if they could not distribute these immobile minerals to all plant parts.

Tillandsia balbisiana was selected to study calcium-45 uptake and transport by applying the isotope to either roots or leaves. On termination of the experiment, plants were harvested and divided into comparable morphological parts. Results demonstrate calcium-45 transport basipetally from leaves of foliar-treated plants to all plant parts. The present study further indicates that actively growing roots are capable of mineral absorption, but it is doubtful if root uptake would be significant, under field conditions. (Work supported by NSF Grant GZ-1115.)

(29)

Lactic and Pyruvic Acid Changes in Bluegill Sunfish (*Lepomis macrochirus* Rafinesque) During Gradual Hypoxia at Two Acclimation Temperatures (5° and 20° C)

DENNIS T. BURTON, *Virginia Polytechnic Institute*

One of the most characteristic responses to anaerobic conditions by vertebrate animals is the accumulation of lactic acid in the tissues and body fluids. This study was undertaken to investigate the changes in skeletal muscle and liver lactate and pyruvate concentrations during the development of hypoxia. Two groups of 15-20 cm bluegills were tested at their acclimation temperatures — at 20° C during August and September; at 5° C during November and December. Experimental fish were exposed to a gradual eight-hour hypoxic stress in continuous flow test chambers. Dissolved oxygen concentrations were reduced in steps at half hour intervals from saturation to zero concentrations. Skeletal muscle and liver from at least eight fish at seven different oxygen concentrations were analyzed for lactic and pyruvic acid.

At each temperature lactic acid increased in both muscle and liver at very low oxygen concentrations; the pyruvic acid concentration was relatively constant throughout. Thus the lactate/pyruvate ratio increased at low oxygen concentrations. This indicates a shift to anaerobic metabolism in these tissues. Lactic acid concentrations were significantly higher at 20° C than at 5° C. Pyruvic acid concentrations were similar at both temperatures. Fish at 5° C could tolerate lower oxygen concentrations than those at 20° C. The data suggest that acclimation to cold temperatures has survival value for fish exposed to hypoxia.

(221)

A New Acanthocephalan (Gigantorhynchidae) from the Bob-White, *Colinus virginianus floridanus* (Coves)

ELON E. BYRD, (Zoology Department) AND FORREST E. KELLOGG (Southeastern Cooperative Wildlife Disease Study) *University of Georgia, Athens*

One pair of a new species of a mature acanthocephalan parasite was recovered from the small intestine of a mature male Bob-white, *Colinus virginianus floridanus* (Coves) in July, 1968. The host was one of 190 specimens of the quail searched from Tall Timbers Refuge, Leon County, Florida, during 1968-1969. The new acanthocephalan is tentatively placed in the genus *Mediorhynchus*

van Cleave, 1916, and appears to be more closely related to *M. papillosum* van Cleave, 1916, than to the other members of the genus. The new species, however, can be distinguished from *M. papillosum* by its larger body size, greater number of hooks and spines on the proboscis, the much longer lemnisci and the musculature of the proboscis receptacle.

(193)

Bioenergetics of *Hyphantria cunea* (Drury), (Lepidoptera: Arctiidae)

JAMES T. CALLAHAN

Hyphantria cunea (Drury), Lepidoptera: Arctiidae, is considered to be an economic pest in outbreak proportions since the larvae of the species are defoliators of some trees of commercial value. Additionally, it has been reported that the larvae feed upon the leaves of certain other money crops as cotton and soybean. The population dealt with in these studies is presumably confined to *Diospyros virginiana*, the persimmon, as a host tree.

Studies were performed to determine the calorie/gram ratios for the various instars of *H. cunea*. Additionally, studies of ingestion and egestion rates were performed to determine the assimilation efficiencies for the third through last instars.

(143)

Sorption of Six δ -Triazines to Proteins

N. DWIGHT CAMPER, *Clemson University*

Sorption of six δ -triazines to three different proteins at 30° C and pH 7.5 was determined. A Sephadex dialysis method was established for sorption determinations and found to give identical results to those obtained with a partitioning technique. Sorption increased with increasing protein concentration and varied with the protein examined. The extent of sorption was influenced by the type of substituent on the 2-position of the heterocyclic ring. Sorption was greatest with the chlorinated derivative. Substitution at the 4- and 6-positions also affected the amount of sorption; i.e., substitution of a propyl for an acetyl group on the amino substituents at these positions resulted in increased sorption.

(133)

In Vitro Growth of Black Cherry (*Prunus Serotina*) Callus: Effects of Medium, Environment, and Genotype (Angiospermae, Rosales, Rosaceae)

JAMES D. CAPONETTI, *The University of Tennessee, Knoxville*,
GERALDINE HALL AND ROBERT A. FARMER, JR., *Tennessee Valley Authority, Division of Forestry Development, Norris, Tennessee*

Callus cultures were established from cambial explants on a basic medium supplemented with coconut milk and 2,4-D, and were successfully subcultured on completely defined media. Growth was graded at relatively high temperatures (26-32° C) in the dark. Broad, genotypic (clonal) variation in growth was observed in several environments. Growth rates of cultures from physiologically juvenile and mature trees were not significantly different.

(161)

Taxonomic and Ecological Studies of Cave Planarians (Turbellaria: Tricladida: Planariidae)

JERRY H. CARPENTER, *University of Kentucky*

Approximately 20 species of cave planarians have been described from the U.S., but only 5 of these have been seen alive by the original authors. As a result, several errors have been made in the descriptions, and very little behavioral and ecological information has been reported. During the present study which was initiated in June, 1968, the author collected live planarians from over 50 caves in 11 states in order to properly revise the taxonomy of this group of planarians. In addition, photographs and observations of living animals, as well as specimens preserved by special techniques, have provided interesting information about locomotory movements, feeding, and litter sizes.

(129)

A New Method for Synchronizing Some Algal Species that Divide Preferentially in Darkness

JACK W. CARROLL, JERRY THOMAS,
CHARLES DUNAWAY, AND JOSEPH C. O'KELLEY
Department of Biology, University of Alabama

Three algal species (*Protosiphon botryoides*, *Chlorella pyrenoidosa* and *Chlamydomonas gymnogama*) which divide preferentially at night during natural or simulated day-night conditions are shown to have cell division inhibited by light in the blue region of the visible spectrum (400 to 500 nm) and stimulated by the remainder of this spectrum (500 to 730 nm). Synchronous division has been established in cultures of these organisms on a circadian or longer period by alternating fluorescent cool-white light and cool-white with the blue component removed. The specific procedure is suggested as potentially superior to other methods for synchronizing cultures of other algae that prefer in nature to undergo cell division at night. Where this or other procedures do not work well it is finally recommended that an action spectrum for cell division be obtained, since this may provide information for achieving optimal synchrony through the use of other specific wavelength regimes.

(96)

Natural Hybridization Between *Senecio smallii* and *Senecio tomentosus*. (Compositae)

CAYWOOD CHAPMAN, *The University of Georgia*

Two species of *Senecio*, *S. smallii* Britt. and *S. tomentosus* Michx., grow on the granitic rock outcrops of the Piedmont of the Southeastern United States. Natural hybrids may sometimes be found where these two species are biologically sympatric. Traditionally, they have been placed in different sections of the genus. The hybrids therefore represent intersectional crosses. *Senecio smallii* has a chromosome number of $n = 22$ while *S. tomentosus* has $n = 23$. At meiosis the hybrids studied had 22 II's and 1 I and they later had reduced pollen stainability. These two species were transplanted to the greenhouse and the garden. Artificial hybrids including F_1 's, F_2 's and BC's were made. Variations in the natural populations were studied by means of local population samples. The purpose of this biosystematic study

was to learn something of the evolutionary effect, if any, of the natural hybridization between these two species.

(145)

Distribution of E_1 , E_4 , and Fast Esterases in Various Tissues of Mature Maize Plants

WILLIAM E. CHAPMAN AND JOHN W. HARRIS
Tennessee Technological University

Extracts were made from frozen tissue samples of mature corn plants. The extracts were subjected to starch gel electrophoresis and the gels stained for esterase activity. Tissues examined were root, prop root, leaf, stem, husk, silk, young ear, tassels, and pollen. The tissues were analyzed for the presence or absence of the E_1 , E_4 , and fast esterases and for variations in their banding patterns. The results indicate variation in the number of E_1 and fast bands present in different tissues. The E_1 and E_4 esterases could not be clearly demonstrated for certain tissues. Fast esterases were found in all tissues examined.

(224)

Parasitemia, Anemia, and Mortality of Neonatally Thymectomized Hamsters Infected with *Plasmodium berghei* (Telospora; Eycoccidia; Plasmodiidae)

WILLIE L. CHAPMAN, JR. AND WILLIAM L. HANSON
School of Veterinary Medicine, University of Georgia

Golden hamsters (*Mesocricetus aureatus*) thymectomized within 30 hours after birth develop more severe parasitemias, anemias, and increased and more rapid mortality than unoperated or sham operated controls when challenged with *Plasmodium berghei*. Following infection of 8 week old hamsters with 15×10^6 parasitized RBC, unoperated and sham operated controls reach a maximum parasitemia of approximately 30% by 17-19 days while the neonatally thymectomized group develops a parasitemia of 50-55% by 15-17 days. Most of the thymectomized hamsters die 14-18 days post infection, and the majority of controls die 16-32 days following infection. Hamsters infected at 4 weeks of age respond similarly to those infected at 8 weeks of age with the exception of a more rapidly developing parasitemia and mortality in the younger animals. The thymectomized group developed maximum anemia (PCV of 12%) by day 14, while the maximum anemia (PCV of 15%) in the controls was observed one day later.

(242)

Comparative Radiosensitivity in the Class Insecta

DON S. CHERRY, *Clemson University*

A single, acute dose of 15,000 rads of gamma radiation was used to treat 12 insect species populations. A "Radiosensitivity Index" which relates the LT-50 of the treated population with the mean longevity of the species was employed to evaluate their relative radiosensitivity. Lepidopterans, which were short-lived, were found to exhibit a high degree of radioresistance to treatment while the longer-lived Orthopterans were radiosensitive. Redative differences between male and female Orthopterans indicated that the female was slightly more radioresistant. In general, the preliminary results indicated

that there was no readily apparent relationship between phylogeny and radiation sensitivity. The results are compared with relevant studies in the literature followed by a discussion of the implications and applicability of the approach.

(43)

Osteological Studies of the Musk Turtles (Chelydridae: *Sternotherus*)

ANN McBRIDE CHILCUTT AND CRAWFORD G. JACKSON, JR.
Mississippi State College for Women

Sixty-eight specimens, representing all five of the currently recognized (Tinkle, 1958) living musk turtles: *Sternotherus odoratus*, *S. minor minor*, *S. m. peltifer*, *S. carinatus*, and *S. depressus*, were studied in detail. The major diagnostic characters were found to be the presence or absence of a hooked maxillary beak, the position of the *foramina carotico-pharyngeale*, the presence or absence of the *foramina arteriaevidianae*, the opisthotic contact with the quadrate, and the morphology and position of the vomer. Because of its strongly hooked maxillary beak, "deteriorated" condition regarding the *foramina carotico-pharyngeale*, and decreased relative interorbital width, *S. carinatus* appears to be closest to the postulated ancestral stock. However, the paucity of paleontological data make such assignment quite tentative. *S. depressus* and *S. m. minor* appear to be the most highly specialized forms on the basis of the remarkable flattening of the shell in the former, and the enormous relative expansion of the triturating surfaces of the jaws in the latter form.

(122)

Morphological Studies on the Miracidium of *Schistosoma mansoni* (Trematoda: Schistosomatidae)

JANET R. CLARKE, *Florida State University*

With the light microscope, after silver nitrate treatment, 22 epidermal plates in a 6:9:4:3 pattern were observed. Structures described by others as sensory papillae, gland duct openings, and excretory pores were also seen between epidermal plates and on the terebratorium.

In scanning electron micrographs, the surface of the terebratorium appeared highly wrinkled, and pore-like structures in positions similar to those shown in the silver nitrate studies were seen on miracidia sheared of their cilia. Preliminary studies with transmission electron microscopy have revealed some details of the ultrastructure of the germinal cells, epidermal plates, nerve mass, penetration glands, flame cells, apical gland, and presumed sensory structures.

(63)

A Study of *Vacuolaria virescens* Cienkowski

ELTON C. COCKE AND LORRAINE B. SPENCER
Wake Forest University

Vacuolaria belongs to the Chloromonadineae, a rare, sporadically occurring, poorly understood group of Protista. The organisms are rarely encountered and are extremely difficult to handle, culture, and fix for cytological studies. The only certain account of *Vacuolaria* occurring in the United States before we collected it in abundance in March 1967 was by Graffius, 1966, who reported having collected few specimens from Michigan,

Ohio and Pennsylvania. The work of Cocke and Spencer (1968), which is being continued and is reported here represents the only detailed study of *Vacuolaria* in America. The morphology of both the flagellated and palmeloid stages, the cytology, mitosis and cell division, and cyst formation have been fairly well established in this study. Some preliminary pigment studies have been undertaken, however, the results of these are not conclusive at the present time.

(62)

Aplanospore Formation and Germination in *Spirogyra singularis* Nordst.

ELTON C. COCKE AND NATHANIEL H. WOODING, JR.
Wake Forest University

In the fall of 1968 a few filaments of *Spirogyra* showing aplanospores were found in a collection made from a lake in Tanglewood Park, Forsyth County, North Carolina. Additional collection made in the same general area in the spring and fall of 1969 yielded more of the alga with aplanospores. While the material was never abundant in any collection, many of the filaments in each collection showed an abundance of aplanospores. No evidence of conjugation has been observed in any of the material collected. For this reason we are considering the spores to be aplanospores, rather than parthenospores. After the cultures have been kept in the laboratory from several days to a month or more, the aplanospores germinate and produce normal filaments. The germlings frequently show a rhizoid-like basal cell. We have not found any record in the literature of aplanospore formation in *Spirogyra singularis*.

(146)

Preliminary Studies of Neurosecretion in *Limax*

JERRY ALAN COHEN AND ERNEST L. HUNT
Emory University

Although the phenomenon of neurosecretion appears to be common in molluscs, relatively few studies have been made in this group. In the present work the circumesophageal nerve rings of *Limax* were studied in detail in normal and experimentally modified slugs. The aldehyde-fuchsin technique was used as a possible indicator of neurosecretory activity. It was found that aldehyde-fuchsin staining granules regularly occur in the metacerebra and mesocerebra as well as in their communicating axons, in the pleural, parietal and visceral ganglia and their communicating axons, and in the region of the otocysts of the pedal ganglia. The patterns of granulation were altered to some extent by desiccation and by the removal of the optic tentacles. It is felt that the aldehyde-fuchsin staining granules observed may be products of neurosecretion, since the patterns of distribution of aldehyde-fuchsin staining granules are constant from animal to animal, the granules are found in axons, certain cell groups show definite cyclic patterns of secretion, and the general secretory pattern is altered by physiological changes.

(53)

Developmental and Ultrastructural Studies of Microfungi

G. T. COLE AND H. C. ALDRICH
University of Florida

Developmental studies of microfungi (Hyphomycetes) have revealed several unsuspected mechanisms of sporo-

genesis. Through the use of time-lapse photomicrography, we have been able to analyse the differentiation of the conidiogenous cell prior to and during conidium formation. In *Scopulariopsis* Bain. and *Tritirachium* Limber, a period of vegetative growth at the conidiogenous cell apex normally occurs after the production of each conidium. This regular succession of proliferation and sporulation is demonstrated by time-lapse photomicrographic sequences. Cytological changes in the conidiogenous cell associated with the developmental process are currently being explored with the electron microscope and the results of our examinations are reported.

(77)

Effect of Chronic, High-Intensity Radiation Stress on Species Composition and Respiration of Forest Litter and Soil

D. C. COLEMAN AND G. T. COWLEY
University of Georgia and University of South Carolina

In a study of micro-flora and -fauna of a hardwood litter and soil community, six 0.6 m² enclosures were irradiated with a 9,000 curie ¹³⁷Cesium source for 113 days. The plots, enclosed to prevent immigration or emigration of soil fauna, received cumulative dosages ranging from 5 million rads to 4 thousand rads.

Marked reductions in soil fungal species were achieved in the first three enclosures (see next presentation), and soil microarthropods were essentially 100% killed in them. "Soil respiration," measured as CO₂ evolution, was reduced to 45-50% of control levels during irradiation and gradually increased during the post-irradiation period. Microflora are apparently major contributors to overall respiration, but the absence of small arthropods from the system may have significant long-term effects.

(78)

Effect of Chronic Radiation on Forest Soil Microfungal Populations

G. T. COWLEY AND D. C. COLEMAN
University of South Carolina and University of Georgia

The six experimental plots and two control plots described in the previous presentation were sampled for three months prior to irradiation and monthly after irradiation to ascertain effects of irradiation on soil microfungal populations. Upon termination of irradiation the numbers of viable propagules in samples from the first three sites ranged from 1-30% of comparable samples taken before irradiation. Populations in sites 4 through 6 increased as much as 200% while those of control sites changed little.

Changes in species composition of heavily irradiated plots were striking. Prior to irradiation similarities between populations of different sites were rarely below 50%. After irradiation populations from the first three sites and control sites were only from 2-6% similar. Pigmented yeasts were predominant among isolates from the heavily irradiated site.

(31)

The Effect of Thyroxin and Cold Exposure on Brown Adipose Tissue Metabolism in Rats

JUNE H. COOLY AND SAMUEL R. TIPTON
University of Tennessee

Male thyroidectomized rats were exposed to 25°C or 8°C for one week. Approximately twenty hours before death, animals were given a single intraperitoneal injection of L-thyroxin (12.5 or 50 µg/100 grams body weight) or an equivalent volume of 0.01 N NaOH (controls). The oxygen consumption of brown adipose tissue (BAT) slices from 8°C animals was significantly higher than in 25°C controls. Thyroxin did not alter the oxygen consumption of BAT even when three doses of 50 µg/100 grams body weight thyroxin were given. BAT glycerokinase activity was increased by cold exposure. Thyroxin depressed glycerokinase activity in 8°C animals. Lipase activity of BAT was elevated in cold exposed animals. Thyroxin decreased the lipase activity in 25°C animals, but had no effect after cold exposure.

(201)

The Effects of Chronic Gamma Irradiation on Snails¹

J. L. COOLEY²
Radiation Ecology Section, Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

The effects of chronic gamma (⁶⁰Co) irradiation on the population dynamics of snails (*Physa heterostrophia*) were studied in the laboratory. Groups of snails of known age (50 days) were exposed throughout their life span to dose rates of approximately 25, 10 and 1 rad/hr. A significant decrease in fecundity from the controls was found for all three dose rate groups. Differences in mortality were found for only the two higher dose rate groups. Populations of snails exposed to 25 rads/hr became extinct in one generation; populations exposed to 10 rads/hr became extinct in two generations. Populations exposed to 1 rad/hr would not become extinct over many generations. However, if the results for populations exposed to 1 rad/hr are extrapolated over thirty generations, a significant reduction in population size can be expected.

¹ Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

² Oak Ridge Graduate Fellow from The University of Tennessee under appointment from Oak Ridge Associated Universities.

(228)

The Impact of a Jetport

FRANK C. CRAIGHEAD, Sr. *Collaborator*
Everglades National Park; National Geographic Society

The southern tip of Florida forms a great fresh water basin rimmed by coastal levees; to the east the pine-land ridge; to the west the coastal sand dunes; to the south a massive crescent of mangroves. This great swamp has been perfected over the last 5000 years by the interaction of many forces. The more important are a rising sea, hurricanes, frosts, periodic fires, a mild climate of wet summers and dry, sunny winters. During the rainy season lush organic matter forms; during

the dry season this in part is broken down. These two metabolic processes provide food for a remarkably abundant and unique plant and animal life. Man's impact for seventy years has been increasingly disruptive. Much of the ecosystem is already destroyed. A realization of this is urgent in reference to an imposition in this area of a Jetport. There may still be time to reverse this destructive impact and save the Everglades. Restoration could be accomplished by confining developments to the east and west highlands, reserving the great central swamp including the mangroves for the future well being of man. Limited agricultural developments and planned recreational purposes could be permitted. Rigid management may restore natural environments—clean water, abundant food, wild life and those aesthetic values required by man to escape the indefinable stress of population pressure. Man cannot utilize both the highlands and the lowlands and still maintain their amenities.

(223)

Seasonal Variation of a New Species of Myxosporidian Parasite (Sporozoa, Myxosporidea, Myxobolidae) of the Bluegill Sunfish, *Lepomis macrochirus* Rafinesque, in Kentucky

STEPHEN B. CRIDER, *Western Kentucky University*
JOHN D. PARKER, *Oklahoma State University*

A new species of myxosporidian parasite (Sporozoa, Myxosporidea, Myxobolidae) has been found on young-of-year and yearling bluegill sunfish, *Lepomis macrochirus* Rafinesque, in Kentucky. The parasite exhibited seasonal variation, both in incidence, and size of cysts. Highest observed incidence occurred in August, 1969, when 51% of the fish in samples were found to harbor the parasite. The life history of the parasite and some aspects of its ecology have been investigated.

(234)

The Biological Recovery of the Clinch River Following a Fly-Ash Spill

JOHN S. CROSSMAN, JOHN CAIRNS, JR.
AND KENNETH L. DICKSON
Virginia Polytechnic Institute

On June 10, 1967, the dike surrounding a fly-ash settling pond collapsed at Appalachian Power Company's steam power plant near Carbo, Virginia. In less than an hour 400 acre-feet of alkaline water entered the Clinch River. For approximately ninety miles below the spill site populations of aquatic organisms were severely damaged.¹ Beginning July 1, 1969, twenty-one sampling stations were located on the Clinch and related tributaries and bottom fauna samples were collected using bottom nets and Surber samplers. Fish were also seined at six stations. The bottom fauna samples showed recovery of the invertebrate populations as analyzed by the Sequential Comparison Index.² However, mollusc species that were found above the spill site were absent below. Further examinations also showed a difference in the density of the organisms above the spill site to those below. These results indicate recovery of the river from the effects of the spill but not full recovery. (Research supported by The Appalachian Power Company.)

¹Federal Water Pollution Control Administration, Clinch River Fish Kill, June, 1967

Tennessee Valley Authority, Fish-Kill on Clinch River below Steam-Electric Power Plant of Appalachian Power Company, Carbo, Virginia, June 10-14, 1967, July 7, 1967

²Cairns, John, Jr., et al., J. Water Pollution Control Federation, 40, 9, 1607 (1968).

(71)

Secondary Succession Following Hay-pasture in the Georgia Piedmont

CHARLES DANIEL, *Georgia College*

At Panola Mountain, Georgia, a hayfield-pasture was abandoned from agriculture in 1965. Old-field studies began with fourth year succession in 1969. Part of the field was reseeded to new grass to establish initial succession stages. A regular environmental analysis was begun including soil and air temperatures, rainfall amounts, and available soil moisture.

For fourth year succession 83% of the dry weight biomass (979 g/m²) was composed of the dominant, *Festuca elatior*, in early July, decreasing to 75% (1026 g/m²) in September samples. *Sorghum halepense* was the aspect dominant of the fall and winter. Primary productivity species formed a simple ecosystem with few tree invaders present. Of the trees *Acer negundo* was most frequent while *Pinus echinata* with plentiful seed sources had low density.

(147)

Studies on the Induction of Chondrogenic Activity in Notochordal Cells from *Rana clamitans* Larvae

ELAINE J. DAVIS AND ROY HUNTER, JR.
Atlanta University

There is a considerable body of literature to affirm the role of the embryonic notochord as an inducer of chondrogenesis. Yet, a question remains as to the capacity of the notochord at any stage to become induced to form cartilage or to calcify. In this investigation, light and electron microscopical observations have been made on notochordal cells isolated from *Rana clamitans* larvae (Class Amphibia; Order Anura). These cells were exposed to a culture medium (Holtfreter-Dextrose) containing 0.03% estradiol benzoate or parathormone, at a temperature of 26 or 37.5°C for 48 to 72 hr. Sites of chondrogenic activity could be detected in all experimental cultures. These sites were indicated initially by differential staining procedures. Similar sites were not found in nontreated tissues. These data suggest that the notochord, at least at the larval stage, is capable of becoming transformed into cartilage, thus adding another dimension to its capabilities.

(44)

Studies of the Courtship Patterns of Turtles

JOHN D. DAVIS AND CRAWFORD G. JACKSON, JR.
Mississippi State College for Women

Detailed studies of the courtship patterns of turtles were undertaken using a variety of high-speed photographic techniques and other image-forming high resolution methods. A reinvestigation of the long known, published account of the courtship behavior of *Pseudemys scripta* which had been based on direct visual

observation, revealed striking discrepancies in the details of the behavior. The fine details of patterns of species whose courtship behavior was previously unknown have been recorded and are being qualitatively and quantitatively analyzed. It is hoped that the accumulating data from different taxa will prove to have taxonomic and phylogenetic significance.

(152)

Survival and Functioning of Autoplastic, Homoplastic, and Xenoplastic Pituitary Grafts in the Newt (Amphibia)

JAMES DENT, *University of Virginia*

Hypophysectomized red spotted newts [*Notophthalmus* (*Triturus*, *Diemictylus*) *viridescens viridescens*, Rafinesque] received autoplastic, homoplastic or xenoplastic grafts of pituitary glands beneath the lower jaw.

Autografted animals, in accord with previous observations, survived indefinitely. Homografted animals had a mean survival time several times longer than either that of unimplanted, hypophysectomized animals or that of homografts of skin. Great variation was seen among the mean survival times of animals with xenografts. Newts with pituitary grafts from the frog, *Rana pipiens*, survived about as long as unimplanted hypophysectomized animals. Pituitary grafts from the salamander, *Desmognathus monticola*, apparently gave rise to some toxic reaction since their host newts died within short periods of time, yet newts with grafts from the mudpuppy *Necturus maculosus* lived longer than hypophysectomized control animals and some newts grafted with glands from a west coast newt, *Taricha torosa*, lived indefinitely. (Work supported in part by US Atomic Energy Commission.)

(79)

A Program of Remote Sensing and Analysis of Natural Environments

H. R. DE SELM, CLIFFORD AMUNDSEN, PAUL KRUMPE
The University of Tennessee—Knoxville

The DC-3 is being used to fly a group of Hasselblad cameras containing color and infra red false color films, with various filter combinations, to sense Cumberland Mountain and Great Smoky Mountain landscapes. The plot technique is used to establish ground truth with respect to topography, soil and vegetation. The reliability of the final film—established truth will depend upon predictive statements made from photography of known ground truth areas using patterns, colors and densities from narrow-band transmittance filters.

(236)

The Use of a Basket-Type Artificial Substrate Sampler for Stream Pollution Monitoring

KENNETH L. DICKSON, JESSE C. ARNOLD
AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute

The use of a limestone filled basket-type artificial substrate bottom sampler for collecting aquatic invertebrates in pollution monitoring revealed that the results obtained were more reliable when evaluated in terms of the number of taxa than in terms of the number of specimens. Fifteen replicate basket samplers at Station

1, located on the New River near McCoy, Virginia, had a range of 23 to 16 taxa with a coefficient of variation of 11.6% and a range of 71 to 32 specimens with a coefficient of variation of 10.9%. Station 2, five hundred yards upstream with sixteen replicate samplers, had a range of 23 to 12 taxa with a coefficient of variation of 16.2% and a range of 142 to 39 specimens, which was larger than the average of 85.6 specimens per sampler, with a coefficient of variation of 18.3%. An estimate of the proportion of taxa which would have been detected on the average by a smaller number of basket samplers showed that at least five basket samplers were necessary at each station to be 95% confident that at least 50% of the total number of taxa were collected. Due to the variability between samplers, we concluded that no fewer than five basket samplers would have adequately evaluated the invertebrate population sampled in this study. (Research supported by Manufacturing Chemists Association.)

(215)

Some Ecto- and Endo-parasites of the Cattle Egret, *Bubulcus ibis* (Aves, Ciconiiformes, Ardeidae), in Alabama

JOHN F. DISMUKES AND JEANNE J. STUART
Auburn University

The parasites of the cattle egret, a relative newcomer to the United States, have been studied little in this country, with no published accounts of internal parasites. Two birds from central Alabama and six from south Alabama were examined for external and internal parasites. External parasites found were the chewing louse, *Ciconiphilus decimfasciatus* (Mallophaga), and the hippoboscids fly, *Ornithoeca confluenta* (Diptera, Hippoboscidae). Internal parasites found were *Physaloptera* sp. (Nematoda, Physalopteridae), probably an accidental; *Habronema* sp. (Nematoda, Spiuridae); and *Hadjelia* sp. (Nematoda, Spiuridae). Numerous specimens of *Microtetraneres spiralis* (Nematoda, Tetrameridae), several specimens of *Synhimantus invaginatus* (Nematoda, Acuariidae), and a single specimen of *Nephrostomum ramosum* (Trematoda, Echinostomidae) were recovered. These latter three species are of especial interest, as all are recorded here for the first time in the Western Hemisphere.

(57)

Microscopic Characters and the Taxonomy of *Clavicornona*

JAMES L. DODD, *University of Tennessee*

Clavicornona is characterized microscopically as exhibiting gloeoplerous hyphal systems, asperulate, amyloid spores, and inflated, clamped hyphae. The gloeoplerous hyphae contain materials staining positively in sulfoaldehydes. A gradient of spore asperulation is present in the genus. Terminology previously used for the sterile hymenial structures in *C. pyxidata* is questioned. Possible synonymy of *C. coronata*, *C. piperata*, *C. Petersii* and *C. pyxidata* are discussed. Phylogenetic relationships of *Clavicornona* within the family Hericiaceae are mentioned briefly.

(206)

The Taxonomic Status of *Matelea* Aublet (Asclepiadaceae) in the Southeastern U.S.

DONALD J. DRAPALIK, *Georgia Southern College*

Nine species of *Matelea* are recognized in the southeastern United States. Three of these species — *M. alabamensis* (Vail) Woodson, *M. pubiflora* (Decaisne) Woodson, and *M. gonocarpa* (Walter) Shinnery — are not morphologically related to one another or to the other six species. The other six species — *M. flavidula* (Chapman) Woodson, *M. floridana* (Vail) Woodson, *M. carolinensis* (Jacquin) Woodson, *M. decipiens* (Alexander) Woodson, *M. obliqua* (Jacquin) Woodson, and *M. baldwyniana* (Sweet) Woodson — are morphologically and genetically related. None of these nine species is ubiquitous. All except two species are usually found growing in semi-shade on the upper areas of south, east, or west facing slopes at the margins of mesic, oak-hickory, mixed hardwood forest. The two exceptions include *M. gonocarpa*, which is usually found in the relatively more moist upper terraces of floodplains, and *M. pubiflora*, which always occurs in the relatively drier turkey oak-longleaf pine forests.

(209)

Vascular Floristic Study of a Southeastern Blue-ridge Escarpment Gorge

DAVID M. DuMOND, *North Carolina State University*

This study, supported by Highlands Biological Station, constitutes a survey of the vascular flora of the Chattooga River Gorge, located along a portion of the Jackson-Macon County line in North Carolina and the northern-most boundary between Georgia and South Carolina. Climatological data and relative river gradients are examined for the same general section of the escarpment.

Seven broad vegetation types are recognized as characteristic of the gorge: (1) mixed mesophytic is of rare occurrence, being located in northerly oriented coves or river slopes; (2) white pine-mixed deciduous has as a whole a successional character; (3) scarlet oak-chestnut oak-hickory is found throughout the gorge and is the most common type; (4) pitch pine-oak is found mostly on xeric peaks and ridges with strong southerly aspect; (5) flood zone vegetation along the river varies in relation to the frequency of flooding and nature of substrate; (6) rock outcrops have xeric and mesic phases; (7) disturbed areas are scattered throughout.

(67)

Migration of Woody Plants into an Isolated Pine Plantation

WILBUR H. DUNCAN, *University of Georgia*

Many seedlings of woody plants appeared in a *Pinus taeda* plantation near Athens, Georgia. When the pines were 11 years old quadrats were established and one- and two-year old seedlings counted and recorded by species. Of the eight species present, four had non-winged and four winged seeds. Species with the most one-year seedlings were, on an acre basis, *Prunus serotina*, 1989; *Quercus nigra*, 1289; *Liquidambar styraciflua*, 289; and *Ulmus alata*, 167. Evidence is presented showing that the many non-winged seeds involved were brought by birds; transmission by mammals is prevented by barriers. Since mammals ate few, if any,

seeds brought by birds, the seedling numbers reported for species with non-winged seeds are a measure of plant migration potential of birds only, apparently the first such data for the Southeastern Piedmont.

(158)

Invertebrate Zoology Today — What is it and what are the trends?

DEE S. DUNDEE

Louisiana State University, New Orleans

When serious consideration is given to the nature of an Invertebrate Zoologist, one wonders if there is truly such a person. The tendency seems to be towards specialization and one also wonders how a person who calls himself an Invertebrate Zoologist might fare in today's job market. And what are the trends in types of studies of invertebrates occurring and being funded today? Surveys reveal that most of the efforts up to now have been involved with systematics and distribution studies but we are gradually becoming involved in ecological, behavioral, and developmental (reproductive biology) aspects of these organisms. Some areas such as genetics are virtually untouched by the so-called Invertebrate Zoologist.

(148)

Some Effects of Acidic, Alkaline, and Neutral Salt Solutions on the Notochordal Sheath of *Rana clamitans* Larvae

KIAH EDWARDS, III AND LOUIS E. CROSSLEY
Wiley College

The notochordal sheath of larval amphibians (*Rana clamitans*, class Amphibia, Order Anura, Family Ranidae), which is found directly around the peripheral and vacuolated notochordal cells, consist of two components; an inner fibrous and an outer elastic lamella. In an effort to confirm data on the chemical nature of the sheath, sections of tissues from the notochordal sheath (which was isolated from the surrounding tissue by incubating in a 2% versene solution at 37.5 c. for 4 hr. and then separated by mechanical means) were observed before and after treatment with 10% Acetic Acid, 0.1M Calcium Hydroxide, and 10% Sodium Chloride (pH7.0). Acetic acid treatment resulted in a disruption of the compactness of the reticulum and partial dissolution of the inner fibrous lamella. The effects of calcium hydroxide on the sheath were similar to the acetic acid. The sheath was unaffected by the sodium chloride. The outer elastic lamella of the sheath was not affected by the solubilizing agents, either singly or in combinations, and remained intact. These data confirm the collagenous nature of the inner fibrous lamella by its dissolution in the presence of weak acids and alkalies; however, the collagenous nature of the reticulum appears to be different from that of the fibrous lamella. The precise nature of the elastic lamella still remains unknown.

(83)

Burrowing Patterns of Seven Species of Haustoriid Amphipods (Crustacea, Amphipoda)

CHRISTOPHER A. ELDERS

University of Georgia

JAMES D. HOWARD

University of Georgia Marine Institute

Haustoriid amphipods have long been known to be active burrowers in the intertidal zone. Using time-

lapse x-ray radiographic techniques and plexiglass aquaria connected to a flowing salt water system, the over-all burrowing patterns of seven species of *Haustoriid* amphipods were studied. The burrowing pattern is considered to consist of the burrowing rate, burrow width, burrow orientation, burrow geometry, concentration, and bioturbation. The burrowing pattern is found to be unique for each species studied, and in the case of such truly sympatric pairs as *Neolhaustorius* and *Haustorius*, and *Parahaustorius* and *Acanthohaustorius*, the burrowing patterns are found to be complementary. This is considered effective in reducing competition, and the application of this to the Competitive Exclusion Principle is discussed briefly.

(134)

Glycolate Metabolism in *Chlorella pyrenoidosa*

J. H. ELEY, *University of Kentucky*

The excretion of glycolate by *Chlorella pyrenoidosa* was studied as a function of CO₂ concentration during growth. Cells grown on air (0.03% CO₂) did not excrete glycolate during shorttime photosynthesis in the absence of added HCO₃⁻. The addition of 15mM HCO₃⁻ resulted in glycolate excretion after a one-hour lag. Cells grown on 1% CO₂ in air, however, were found to excrete glycolate without a lag period. Assays for glycolate oxidase activity were performed on cells grown under air and 1% CO₂ in air, and showed higher specific activity for cells grown under air. We interpret the results as an indication that glycolate metabolism in *Chlorella pyrenoidosa* is regulated by CO₂ concentration. Limiting CO₂ favors glycolate synthesis and glycolate oxidase activity, and thus results in minimal glycolate excretion. (Supported by the Kentucky Research Foundation.)

(163)

Methods of Collecting Tabanidae (Insecta: Diptera: Tabanidae)

W. BRUCE EZELL, JR. AND T. R. ADKINS, JR.
Clemson University

Large numbers of deer flies and horse flies (Tabanidae) were collected during the summer of 1969 in Charleston, South Carolina. The majority of the specimens were obtained from a plastic (polyethylene) "canopy trap." Several simple geometric shapes (ball, cube, pyramid, and crossed wooden blades) were used as targets under the "canopy traps." Wooden "Manning traps" were operated with and without carbon dioxide as an attractant. Other flies were taken from black board traps coated with "stickem special." Annoyance and attack rates were determined by netting flies at 200 ft. intervals along a 5000 ft. transect.

(8)

Relationship between Water and Salt Absorption in *Ricinus communis*

WILLIAM F. FARNHAM, *Duke University*

It has been reported that at high rates of transpiration there is no direct relationship between rates of salt and water movement through roots. This was tested by enclosing root systems of six week old plants of *Ricinus communis* in a pressure chamber filled with nutrient solution, with their stumps protruding through the cov-

er. Pressure was applied to the solution, causing exudation at a rate exceeding the rate of water movement caused by high transpiration. The volume of the exudate was measured and the "total salt" content of the exudate was determined from the resistance of the solution. Results of these experiments indicate that there is a direct relationship between "total salt" movement and water flow, even at rates two to three times those usually found in transpiring plants.

(40)

Effect of Temperature and Photoperiod Acclimations on the Water Economy of *Hyla Crucifer*

MICHAEL P. FARREL, *Savannah River Ecology Laboratory*

Water content, desiccation rates and tolerances were ascertained for *Hyla crucifer* acclimated for 3 weeks on a L/D 12/12 at 7 and 20C and on 20C at L/D 6/18, 12/12, and 18/12. Body water content was reduced at both 7C and L/D 18/6. Desiccation tolerances were higher at 7C and L/D 6/18. Desiccation rates were similar for all acclimations. These results suggest that (1) temperature and photoperiod acclimations can influence both body water composition and desiccation tolerance and (2) the higher winter desiccation tolerances (as reflected by 7C and L/D 6/18 acclimations) may reflect a seasonal physiological adjustment to withstand higher water losses during the breeding period and, hence, greater activity period of this species.

(197)

Effect of Hypoxia and Varying Ambient Temperature on the Metabolism of the Old-Field Mouse

ALAN FINK, *University of Georgia*

Oxygen consumption and body temperature were monitored for male and female adult old-field mice, *Peromyscus polionotus*, as they were subjected to varying combinations of hypoxia and ambient temperature. The data indicate that the old-field mouse reduces its body temperature in response to combined low ambient temperature and hypoxia. Oxygen consumption during low-temperature stress was lower under hypoxia than under control conditions; however, the diminished rate of oxygen consumption exceeded the rate of resting metabolism. As the old-field mouse is semi-fossorial, living in a sealed burrow during the day, the experimental conditions would be encountered in the field. This metabolic response should be considered in studying the energetics of the species. Similar responses may occur in other fossorial species; this should be investigated by those interested in the bioenergetics of fossorial mammals.

(151)

Comparative Estrogen Effects on the Uterus of *Peromyscus* (White-footed Mice — Mammalia: Rodentia: Cricetidae)

MARY-FLEMING FINLAY AND WALLACE D. DAWSON
University of South Carolina

Comparative effects of estrogen in two rodent species, *Peromyscus maniculatus* and *P. polionotus*, and their F₁ hybrid were analyzed using uterine assays. Intact 21-22 day old females were injected subcutaneously with estro-

diol benzoate in oil, at 0.05 μ /gram body weight, and killed 6 hours later. Littermate controls were injected with oil. Uterine weight increased 48% in *P. maniculatus*, 39% in *P. polionotus* and 39% in the hybrids. In another group, mature, nulliparous, ovariectomized mice were killed 72 hours after injection with 0.1 μ estradiol benzoate/gram body weight. Uterine weight increased 239% in *P. polionotus*, 135% in *P. maniculatus* and 227% in the hybrids compared with ovariectomized controls. Uterine RNA/DNA ratios increased from 0.46 to 1.04 in *P. polionotus*, from 0.51 to 1.05 in *P. maniculatus* and from 0.44 to 0.94 in the hybrids. These assays did not reveal species differences in sensitivity comparable to those previously demonstrated with vaginal assay.

(7)

Radial Oxygen Diffusion Rates in Plant Roots

EDWIN L. FISCUS, *Auburn University*

The radial movement of oxygen in excised corn and jack bean roots was measured with a platinum wire electrode embedded in the root tissue. Measurements were made with the roots exposed to air and with the roots immersed in nutrient solution in the presence and absence of mM sodium azide. Effective rates of oxygen diffusion in the root tissue were also measured from 5 to 30° and compared to the respiration rates from similar root segments over the same temperature range. The results show that, under conditions which allow the roots to exude freely, the interior of the root operates under an oxygen deficit. Inhibition of respiratory oxygen uptake by low temperature or azide treatment increased the effective rate of oxygen diffusion to the root interior.

(160)

A New Epigeal Species of Isopod Crustacean (Asellidae: *Asellus*) from Virginia

LAURENCE E. FLEMING, *Virginia Polytechnic Institute*

A new epigeal species of isopod crustacean of the genus *Asellus* has been discovered on the Virginia Polytechnic Institute campus in Blacksburg, Virginia. The new species was found in only two localities: a large campus pond and a small marshy area fed by an underground stream. At present it is felt that this new species exhibits several features which may indicate a rather close relationship to a newly described species, *A. kenki* Bowman, 1967. Both species are considered to be intermediate in their relationships between typical epigeal and hypogeal species of *Asellus*. The intermediate position of these two species may be viewed as a likely starting point in an attempt at deriving the evolution of the hypogeal species from their epigeal progenitors.

(32)

Some Properties of L-lactate Dehydrogenase from *Eimeria stiedae* (Protozoa: Coccidia)

JOHN C. FRANSEN AND JUDITH A. COOPER
USDA Regional Parasite Research Laboratory
Auburn, Alabama

L-lactate dehydrogenase (EsLDH) has been partially purified from *Eimeria stiedae*. Preservation of activity is prolonged by *b*-mercaptoethanol. In electrophoresis,

EsLDH behaves as LDH₄. In 0.1 M sodium phosphate buffer pH 7.5, conversion of pyruvate to lactate is maximal at 40 °C. NAD (I), 3-pyridinealdehyde-adenine dinucleotide (II), nicotinamide-hypoxanthine dinucleotide (III), thionicotinamide-adenine dinucleotide (IV), and 3-acetylpyridine-adenine dinucleotide (V), but not NADP, can serve as coenzymes for oxidation of lactate. The reaction rate with II, IV, and V is greater than with I, and the rate ratio V/I is extremely high. The reduced form of III can serve as coenzyme for the reduction of pyruvate, but it is not as efficient, in terms of reaction rate, as the reduced I. The initial results indicate no optimal pH between 7 and 8 for the reduction of pyruvate in phosphate buffer. Apparently this is the first attempt at characterization of a partially purified LDH from sporozoa.

(218)

Quantitative Evaluation of Parasite Populations: Technics for Quick-Freezing Host and Processing Internal and Ectoparasites

FRANK E. FRENCH, HERBERT M. HENRY
AND LOUISE G. HENRY
Georgia Southern College

Quick-freezing the host with its parasites *in situ* enabled deferment of parasite removal until adequate time was available to properly process the specimens. *Sigmodon hispidus* (Mammalia: Rodentia) were killed with chloroform, placed in plastic bags, and submerged in liquid nitrogen. The 16 frozen animals were transferred to a freezer and held at -15° C for 17 days. The cotton rats were allowed to thaw and then individually washed in jars agitated on a paint shaking machine. The wash water was filtered; ectoparasites (Arthropoda: Insecta and Acarina) were collected from the filter paper and mounted on slides. Tapeworms (Cestoidea: Cyclophyllidae) were fixed and stored in formalin until stained. Preliminary evaluation indicates that parasites prepared by routine technics from quick-frozen hosts are suitable for microscopic examination; these specimens were compared with parasites collected from 17 freshly killed control cotton rats.

(48)

Reproduction and Growth of the Endemic Florida Scrub Lizard, *Sceloporus woodi* Stejneger

JOHN B. FUNDERBURG, *Florida Southern College* AND
DAVID S. LEE, *Natural History Society of Maryland*

A field study of *Sceloporus woodi* (Class Reptilia; Order Squamata) extending from June 1965 to July 1968 was conducted on the Lake Wales Ridge near Winter Haven, Polk County, Florida. This study revealed 1) that both sexes reach sexual maturity between 39 and 42 mm S-V length, 2) mating occurs from the end of March until at least the last week in June, 3) females lay 2-4 eggs three to four weeks after copulation, 4) hatchlings which range from 21 to 23.5 mm S-V length are distinctively marked, and 5) sexual maturity may be reached after one year.

(120)

Preliminary Studies on the Function and Fine Structure of the Intestinal Epithelium of *Cotylaspis insignis* Leidy, 1857 (Trematoda: Aspidobothria: Aspidogastridae)

RICHARD D. GARRITY, *The Florida State University*

Cotylaspis insignis (Aspidogastridae), present in a variety of fresh water bivalves, often is found at the

junction of the visceral mass and inner demibranch of *Lampsilis claihornensis* (Unionidae), a common mussel of the Ochlocknee River in Leon and Gadsden Counties, Florida. In order to clarify the type of symbiotic relationship between these two animals, studies have been undertaken to evaluate the degree of nutritional dependence of the worm on the bivalve. Included in these studies is a description of the fine structure of the intestinal epithelium of *C. insignis*. The preliminary results of these morphological studies will be the subject of this presentation.

(91)

The Formation and Early Development of Southern Harvester Ant (*Pogonomyrmex badius*) Colonies

JOHN B. GENTRY AND DOUGLAS M. CARLSON
University of Georgia

Early each summer, mating occurs at the crater surface of southern harvester ant colonies. Each fertilized queen then flies away to attempt to form a new colony. Preliminary studies at the Savannah River Plant indicate that less than one percent of the mated queens are able to establish a new colony. In order to determine the factors which control colony formation, data concerning the developmental stages leading toward an established colony are needed.

A total of 1200 founding colony sites were marked for future relocation. A total of five colonies were excavated at regular intervals during the summer and winter. Eggs were found at 4 days, larvae 9 days, pupae 22 days and adult workers at 29 days after the queens mated. Queens steadily lost weight for approximately 45 days, then began gaining weight as the workers began gathering and storing seeds.

(45)

Evolutionary Considerations of Reproductive Parameters in Turtles (Reptilia: Chelonia)

J. WHITEFIELD GIBBONS

A consideration of reproductive characteristics (such as clutch size, age or size at maturity, sexual dimorphism in body size) suggests certain evolutionary trends in turtles. However, a review of the literature indicates the necessity for more extensive studies, particularly ecological ones, before an understanding of reproductive relationships can be achieved.

Joan R. Gibson (Abstract 211a)

See page 72

(238)

Changes in Plankton Community Structure Associated with the Impoundment of the North River, Alabama

ROBERT A. GIBSON, *University, Alabama*

Reduction in the heavy silt load on reaching impound-

ment conditions resulted in the loss of available nitrates and orthophosphates, and a corresponding reduction in phytoplankton biomass during filling of the North River Reservoir, Alabama.

(68)

The Movement of Beach Dunes on Dauphin Island, Alabama

FRANK GILLESPIE AND ARTHUR GARRETT
University of South Alabama

Dauphin Island is located west of the mouth of Mobile Bay in southwestern Alabama. The island is oriented east and west parallel to the main shore and is approximately 21 km long and 1 to 2 km wide in the area under study. The southern, offshore edge is beach sand with dunes of about 10 m height separating the beach from forest. Landward movement of the dunes has destroyed or threatened not only several man-made structures but also a portion of the island's forest. It was hypothesized that the extensive human disruptions of natural beach vegetation and topography on the island could be demonstrated to have proportionately increased the instability of these dunes. Dune movement in 3 areas of apparently different degrees of disturbance was determined by direct measurements and by the comparison of present dune positions to those shown on surveys taken over the last 20 years. Landward movements were found to be about 0, 20 and 25 m in the three areas. However, the rates of movement were not shown to have been substantially altered by construction in the area. Present conclusions are that human disturbance is less influential than hypothesized and that the observed different rates of dune movement are probably due to natural causes such as prevalent winds and storms.

(33)

Electrophoresis of Motile Protozoa and Algae

STEPHEN M. GITTLESON, WILLIAM PAUL
AND RICHARD L. HOOVER
University of Kentucky

Movements of five unicellular species were observed and were recorded photomicrographically in a Northrup-Kunitz microelectrophoresis apparatus under the influence of an applied electrical field. The voltage was increased across the microelectrophoresis chamber until an effect on the organisms was evident. Usually current strength was about 5 milli-amps.

Tetrahymena pyriformis, *Chlamydomonas reinhardtii* (+) and (-) strains, *Polytomella agilis* and *Polytomella caeca* under these conditions moved toward the cathode. However, *Euglena gracilis* v. *bacillaris* always moved toward the anode. When the polarity across the microelectrophoresis chamber was reversed, the cells of all species turned and again moved toward the original pole. The organisms swam at random until the current was applied. These data indicate that *E. gracilis* carries an external negative charge while the other species possess a net positive charge at their surfaces. The problem of differentiating between electrophoretic mobility and motility of microorganisms will be discussed. (This study was supported by The University of Kentucky Research Foundation and an NIH Biomedical Sciences Support Grant.)

(82)

Terrestrial and Aquatic Orientation in the Starhead topminnow, *Fundulus notti*

C. PHILLIP GOODYEAR
Savannah River Ecology Laboratory

Starhead topminnows from various shores of a small woodland pond were displaced to unfamiliar surroundings and tested in aquatic and terrestrial arenas. These fish used a sun-compass to move in a direction which, at the location of their capture would have returned them to the land-water interface. Directional terrestrial locomotion was accomplished by the fish using the position of the sun to align its body for each jump. On heavily overcast days many fish were unable to orient their bodies in a consistent direction from jump to jump, resulting in random rather than linear movement. Considerable individual variation in terrestrial locomotor ability was evident.

(13)

Growth of *Spartina patens* and *Spartina alterniflora* as Influenced by Nitrogen Source and Salinity

JAMES G. GOSSELINK, Louisiana State University

Growth of *S. alterniflora* and *S. patens* in sand culture in the greenhouse confirmed that these species are facultative halophytes whose growth is inversely related to the salinity of the nutrient solution. As the salinity increased in the nutrient solution, tissue sodium and chloride also increased in the above ground portions of the plant. The relationship of tissue sodium and chloride to the electrochemical equilibrium in the cells is discussed.

In flooded sand cultures ammonium nitrate appeared to be a better source of nitrogen than either ammonium sulfate or sodium nitrate. Fresh and dry weights of plants grown in ammonium nitrate were greater than in the other two nitrogen sources, but survival and tillering did not differ. At the highest salinity (20 parts per thousand sodium chloride) survival of *S. alterniflora* was poor in spite of the fact that it is normally found in more saline areas than *S. patens*. In other tests lower concentrations of nutrients, and/or aeration with air or nitrogen had no observed effects on survival and growth.

(36)

Serum Protein Patterns in Closely-related Groups of the Beachmouse

KENNETH E. GRISWOLD, University of South Carolina

Serum protein polymorphisms were investigated in 196 beach mice, *Peromyscus polionotus*, collected in the wild from 10 sites in western Florida, which includes two locations at opposite ends of Santa Rosa Island. Six subspecies were represented in the total sample. An additional 215 F₁ hybrids were also studied. Variations in albumins, post albumins and β -globulins were detected, using vertical polyacrilimide gel ionographs. Protein variations were widespread in most mainland populations, but the 120 mice from Santa Rosa Island showed essentially uniform patterns throughout. It is postulated that the island population was established from relatively few mice in geologically recent times, and that the founder principle has played a significant role in the genetic structure of the Santa Rosa population. The variations observed in the mainland populations suggests a polytypic origin for these groups.

(19)

Testing the Specificity of Inhibitors of DNA Synthesis for Growth Studies

ALAN H. HABER AND LARRY L. TRIPLETT
Biology Division, Oak Ridge National Laboratory
Oak Ridge

Many growth-studies using a DNA synthesis-inhibitor are based upon an untested premise: that the inhibitor produces no nonspecific growth inhibitions apart from its actions on DNA synthesis. We tested this premise for three chemicals presumed to have a high degree of specificity for inhibiting DNA synthesis. We studied their effects on lettuce seed germination and wheat seedling growth after exposing seeds to gamma radiation that inhibits DNA synthesis. Since DNA synthesis is already inhibited, any additional effects of the inhibitors should be nonspecific inhibitions that can not be attributed to inhibition of DNA synthesis. Very high concentrations of hydroxyurea, somewhat lesser concentrations of 5-fluorodeoxyuridine, and much smaller concentrations of phenethyl alcohol were necessary to demonstrate such nonspecific actions on growth. (Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.)

(225)

Course of Infection of Chloroquine- and Sulfone-Resistant *Plasmodium berghei* (Telosporea: Eucoccidia; Plasmodiidae) in CF-1 Albino Mice

WILLIAM L. HANSON, ANITA BAYLES
AND PAUL E. THOMPSON
School of Veterinary Medicine, University of Georgia

Chloroquine- and sulfone-resistant strains of *Plasmodium berghei* show considerably slower increases in numbers of parasites in CF-1 albino mice (22-28 gms.) following intravenous injection of 15×10^6 parasitized RBC than does the parent strain. Mice infected with the former strains show parasites almost exclusively in reticulocytes with only 3-5% parasitemia by day 7, while those infected with the latter show many parasites in mature erythrocytes, rapid increase in numbers of parasites approaching 90-100% parasitized RBC and death of host by day 7. The drug-resistant strains continue to increase, eventually approaching 100% parasitemia in some animals by days 15-22, with most of the animals eventually dying. Neither sex of mouse host, washing of parasites prior to injection, nor stage of infection of donor animal (1 week, 3-5% parasitemia versus 2-3 week, 50-100% parasitemia) markedly affect the course of infection.

(126)

Correlation Between Structure and Function of Isolated Chloroplasts

GÖTZ HARNISCHFELGER (sponsored by H. Gaffron)
Institute of Molecular Biophysics,
Florida State University

Carefully isolated whole chloroplasts undergo structural changes upon aging and exposure to hypotonic media. The morphological appearance of tobacco plastids in the early stages of disintegration will be shown in a series of electron micrographs obtained with both the scanning and standard sectioning techniques. The

physiological function of chloroplasts is known to depend a great deal on structural parameters. The successive stages of physical appearance of the plastids will be shown to be correlated with distinct changes in the transfer of energy between pigments, and in the photosynthetic electron transport. The yellow pigments, which absorb blue light only, lose their efficiency ahead of that of the chlorophylls.

These studies were supported by grant No. 10-004-018 to Professor H. Gaffron from the National Aeronautics and Space Administration.

(28)

Experimental Diabetes in the Mongolian Gerbil, *Meriones unguiculatus*

JENNIFER S. HARPER AND ERNEST L. HUNT
Emory University

The metabolism of the desert-adapted gerbil has been reported to differ in several ways from the pattern of the usual laboratory rodents. We were particularly interested in determining if the kidney of this form, which normally produces only minimal quantities of urine, could cope with the stress of diabetes. The normal pancreas and kidney were studied along with tissues from a series of animals injected with alloxan. Although a very surprisingly large degree of variation was shown, even among animals injected with the same dosage of alloxan, it was clearly evident that the gerbil is sensitive to alloxan and follows the pattern characteristic of rodents in its physiological reactions. The resultant diabetic condition is typical in its extreme glycosuria and polyuria. Histological examination of the pancreas indicated the usual pattern of destruction of beta cells. At this stage of our work we have not been able to demonstrate extensive kidney damage in the gerbil, and are inclined to believe that the kidney of this form may be more resistant to alloxan-diabetic change than is that of the rat or mouse.

(239)

Penaeid Shrimp Production in a Managed, Unfed, Natural Pond in South Louisiana

ALVA H. HARRIS AND CURT D. ROSE
Nicholls State College

Water control in a 20-acre salt-marsh natural pond was effected by erection of earthen dikes. A weir was constructed to allow tidal flow. Ingressing post-larval shrimp were stocked utilizing night-time flood tides. Screening through hardware cloth prevented entrance of large shrimp and predators. Predator control was exercised by rotenone applications for fish and baited wire traps for crabs. The blue crab, *Callinectes sapidus*, was the most abundant predator and proved uncontrollable with traps. Supplemental food was not added. Brown shrimp, *Penaeus aztecus*, grew to 34-count (heads-on) in 75 days and 12-count in 200 days. White shrimp, *Penaeus setiferus*, reached 34-count in 60 days. Harvesting consisted of draining surface water at night across the weir into a net. Water level dropped no more than 2 inches during any harvest period, and was maintained by day-time flooding. Approximately 70% of the crop was harvested during the first 20 hours of draining. Total harvest was 125 lb. of shrimp per acre. (Supported in part by Sea Grant Program of NSF.)

(25)

Inhibitors Produced by the Colonial Flagellates (Volvocaceae)

DENNY O. HARRIS, University of Kentucky

The production of substances by several members of the family Volvocaceae (Chlorophyta), which are inhibitory to the growth of other algae, has been demonstrated in bacteria-free cultures. Studies are being conducted to completely characterize these substances both physically and chemically. Preliminary results indicate these substances can be diluted several times with no appreciable loss in activity. Further, they are non-dialyzable, destroyed at acid pH and degraded by exposure to temperatures above 50° C. These toxins have been extracted from the cells and a bioassay system has been developed using extracts from *Pandorina morum* as the toxin and *Volvox tertius* as the test organism.

(185)

Effects of Acute Doses of Fast Neutron Radiation on Leaf Area Development and Net Photosynthesis of *Liriodendron tulipifera* L. and *Acer saccharinum* L. Seedlings¹

W. F. HARRIS²

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Oak Ridge National Laboratory, Oak Ridge, Tennessee

The response of 2-year-old yellow poplar and silver maple seedlings to acute, sublethal fast neutron radiation was evaluated experimentally to provide a basis for interpreting landscape phenomena following radiation exposure where environmental factor interaction precludes direct interpretation. Both physiological and morphological effects were considered. For example, at 60 days postirradiation leaf area development for yellow poplar seedlings receiving a 500 rad dose was reduced to 28% that of control plants. Silver maple, a more radioresistant taxon, showed a reduction in leaf area of 50% over the same range of dose and time. Inhibited leaf area development accounted for much of the reduced photosynthetic potential over the growing season. However, immediately postirradiation and at the end of the first growing season net photosynthetic rates on a unit area basis were depressed. Such rate reductions probably relate to causes other than radiation-induced damage to photosynthetic reactions. The overall result of reduced photosynthetic potential clearly implies decreased competitive ability, affecting such plant parameters as biomass production and reserve carbohydrate concentrations.

¹Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

²Oak Ridge Graduate Fellow from the University of Tennessee under appointment from the Oak Ridge Associated Universities.

(202)

Temperature Effects on the Sorption of Radionuclides by Midges (Tendipedidae)¹

R. S. HARVEY, Savannah River Laboratory
E. I. du Pont de Nemours and Company
Aiken, South Carolina

Laboratory studies showed that midge larvae were relatively poor concentrators of ¹³⁷Cs, ⁸⁸Sr, ⁶⁵Zn, ⁵⁹Fe,

⁵⁵Co, and ⁵⁴Mn from a mud-pondwater medium. Water temperatures of 20 to 31° C influenced larval maturation rates but had no major influence on radionuclide sorption by fourth-instar larvae of *Glyptotendipes paripes* (Edw.) and *Chironomus plumosus* (L.). A water temperature of 36° C was lethal for *G. paripes* larvae. Radionuclide concentrations in adults of both species increased slightly with water temperature and with larval exposure prior to emergence. However, greater than 50% of the radioactivity in larvae immediately before metamorphosis was lost by ecdysis.

¹The information contained in this article was developed during the course of work under Contract AT(07-2)-1 with the U. S. Atomic Energy Commission.

(138)

The Enzymatic Nature of IAA Oxidase from the *Avena* Coleoptile

J. H. M. HENDERSON AND ELAINE YAT LAAN TENG
Tuskegee Institute

The enzymatic and proteinaceous nature of the IAA-inactivating substance extracted from *Avena* coleoptiles was examined. Positive results were given when tested with Biuret and Ninhydrin tests. With the addition of 2% trypsin, activity was retarded. In addition, the activity was heat-labile and nondialyzable. The action on IAA was oxidative with R.Q. close to unity (1) as investigated by means of Gilson Respirometer under different conditions of preparations. The nature of the exact reaction remains to be investigated as well as the identification of the end product(s) of the oxidative reactions.

(217)

Intestinal Parasite Populations of *Sigmodon hispidus* as Affected by Host Physiology

HERBERT M. HENRY, *Georgia Southern College*

A total of 353 cotton rats, *Sigmodon hispidus*, was collected from ecologically similar broomsedge communities in southeast Georgia. Stomach and small intestine were examined for adult tapeworms and the liver was examined for larval tapeworms. *Raillietina bakeri* Chandler, and *Aprostotandrya ondatrae* Rausch, were found in the small intestine and larval *Taenia* sp. was found in the liver. The relationship of the numbers of these parasites to sex, size, reproductive condition and to season of the year was analyzed. Preliminary findings indicate that there is a significant difference in the parasite loads between the adult male rats and the adult females. There appears to be no correlation between parasite incidence and reproductive status within a particular sex.

(219)

Population Studies of Mite Ectoparasites of the Cotton Rat, *Sigmodon hispidus*

LOUISE G. HENRY, *Georgia Southern College*

Cotton rats were collected with Sherman live traps from broomsedge fields in Bulloch and neighboring counties. Ectoparasites were removed from 353 rats by the flotation technique. The incidence per host of groups of Acarina, Anoplura and Siphonaptera was determined. The size of these ectoparasite populations

was analyzed to determine if there was a significant correlation between incidence and sex, age and sexual activity of the host and with seasons of the year. There was a definite correlation between seasonal change and certain of the mite species. Six species of mites (Arthropoda: Acarina) were recovered.

(171)

Ovule and Sporogenous Tissue Development in *Cassia abbreviata* Oliver var. *granitica* (Angiospermae: Leguminales: Caesalpinaceae) by the Application of a New Clearing-Squash Technique

J. M. HERR, JR. AND DAVID H. REMBERT, JR.
University of South Carolina

A mixture of several clearing agents, specifically lactic acid, chloral hydrate, phenol, clove oil, and xylene provides a superior clearing fluid uniquely applicable to the study of ovule and sporogenous tissue development. This fluid has been advantageously used in the study of ovule development in *Cassia abbreviata* var. *granitica*. Whole ovularies treated in the mixture for 2-24 hours at room temperature are sufficiently softened to permit removal of the ovules. The ovules are then transferred with the fluid to slides, gently covered, and examined with a phase contrast microscope. From the initial examination, the three-dimensional aspect of ovule curvature and integument development is eminently discernible. The correlative stage in sporogenous tissue development can be detected as well. Progressive squashing with a fine needle gradually spreads the cells apart to reveal cytological features with superlative clarity. The technique provides a new minimum in time and effort required for observing the range of developmental variation.

(182)

Comparative Nutrient Composition of Forest Trees in Central Missouri

LLOYD W. HESS AND F. GLENN GOFF
University of Missouri

The mineral nutrients Ca, K, Mg, N, and P were determined for various tissues of native Missouri trees. Eighteen sites, covering a broad range of forest habitats in Central Missouri were selected and a total of one hundred twelve trees representing twenty five species and nine genera were sampled on these sites. Vertical bark and wood as well as horizontal wood samples were analyzed. A composite leaf sample was analyzed for each tree as well as one and two year old stem samples. Over 6,500 mineral determinations were made. The internal nutrient economy of the tree and the range of variation between trees of single species on the same site and on different sites is described, as well as the relationship of variation in soil nutrient content to variation in nutrient content of the various plant tissues. The role of individual tree species in the overall nutrient economy of the forest is discussed.

(183)

Turnover Rates of the Major Elements in the Tree Leaf Litter of Central Missouri Forests

LLOYD W. HESS AND JOHN J. ROCHOW
University of Missouri

Turnover rates for Ca, K, Mg, N, and P were determined. Twenty sites were chosen to represent the spectrum of forest ecological variation from dry glade-like sites of the Prairie Forest Border Region, through the typical oak-hickory forest, to the mesic sugar maple-basswood areas of the river hills. Site fertility, topography, slope, stand age, species composition, and herbaceous cover, were determined and related to turnover rates. Production was compared over a two year period and related to site fertility.

(95)

Biology of the "Love-bug," *Plecia nearctica* Hardy (Insecta: Diptera: Bibionidae)

L. A. HETRICK, *University of Florida*

This native species has two annual generations with adults emerging in May and September. The adult flies do not sting or bite but the tandem pairs attract attention and are a nuisance to motorists. Eggs are laid in moist soil and larvae feed gregariously on decaying vegetation. Pupation occurs in the locations of larval development. The pairs of mating adults feed on pollen and nectar of flowers blooming at the seasons of adult activity. Very few natural control agents are known. The ecological reasons for the population explosion of this species during the past four years are unknown.

(112)

Study of Arginyl-tRNA Synthetase in a Wild Type and Mutant Strains of *Escherichia Coli*

DOROTHY M. HINTON AND LUTHER S. WILLIAMS
Atlanta University

Two strains of *Escherichia coli* were used in this study. The wild type, NP 3, is canavanine sensitive, possesses normal arginyl-tRNA synthetase activity and arginine biosynthesis is repressible by exogenous arginine. The mutant, NP301, is canavanine resistant and has reduced arginyl-tRNA synthetase activity and non-repressibility of arginine biosynthesis. The results of protein and synthetase assays indicate that arginyl-tRNA synthetase was resolved from DEAE columns as two activities in both wild type and mutant strains. Significantly, the two activities are different in wild type and mutant strains, and exhibit differential thermal stability and P^H optima. Further data indicate that the acceptance activity of each synthetase activity was qualitatively different in all measurements of the rate of attachment of arginine to arginine tRNA in the mutant, as compared to the same synthetase activity in the wild type strain.

(178)

Effects of Thymidine and Thymidine Analogues on 5-Fluorodeoxyuridine-Induced Mitotic Inhibition

GEORGE R. HOFFMANN, *University of Tennessee*

The effects of thymidine and thymidine analogues on the inhibition of mitosis by 5-fluorodeoxyuridine (FUDR) were studied in secondary root meristems of the broad-bean, *Vicia faba*. The suppression of mitosis by different concentrations of FUDR and the recovery of cells in water from the mitotic inhibition induced by FUDR were considered, as was the reversal of inhibition associated with thymidine, 5-bromodeoxyuridine (BUDR) and 5-iododeoxyuridine (IUDR). The reversal phenomena studied included both the protection of roots from the inhibition of mitosis and the enhancement of recovery after the suppression of cell division has taken place.

(162)

The Diplopod Fauna of South America

RICHARD L. HOFFMAN, *Radford College*

The South American diplopod fauna consists of three basic categories: (1) a small ensemble of forms largely confined to Chile, with closest affinities in Australia, New Zealand, and South Africa; (2) numerous taxa with apparently Holarctic centers of origin; and (3) groups with obvious lines of relationship with tropical Africa. Forms of this last category comprise the characteristic endemic South American milliped. Although very abundant and diversified, and with African representation at the level of family, tribe, and possibly genus, they have been notably unsuccessful in spreading northward through Middle America.

The essentially complimentary distribution of orders, and of families within orders, suggests a long separation of northern and southern continental masses and an earlier connection of nearly all of the existing continents to have allowed world-wide spread of primitive ordinal stocks.

(38)

Studies on the Erythropoietic Effect of Corticosterone

G. RICHARD HOGAN
University of North Carolina, Charlotte

It has been demonstrated that certain hormones, such as testosterone, thyroxine, and somatotrophin are effective erythropoietic stimulants. Data reported here indicate that the adrenal factor, corticosterone, exerts a depressor effect on erythropoiesis. Corticosterone-treated mice demonstrate a significantly reduced percentage incorporation of radioactive iron (^{59}Fe) into peripheral erythrocytes compared to incorporation values of control animals. A dose response relationship is observable. Percentages of ^{59}Fe incorporation as a function of time post-corticosterone injection suggest that at least four days are necessary between the final injection and ^{59}Fe administration for depression of erythropoiesis to be manifest. A split dose of corticosterone effectuates a more abrupt reduction of erythropoiesis than a comparable dose given with a single injection. No significant differences in hematocrit values between groups were detected, illustrating that corticosterone effect on

erythropoiesis is not attributable to hemolytic action. (This investigation is supported by a grant from the United Medical Research Foundation of North Carolina.)

(142)

Retention of Water-soluble Compounds During Freeze Substitution

THOMAS HOUSLEY AND DONALD B. FISHER
University of Georgia

Freeze substitution of plant tissues with alcohol is unsatisfactory for the localization of water-soluble compounds due to solubilization in the alcohol. $^{14}\text{CO}_2$ -labelled leaf discs freeze substituted in methanol lost virtually all of their water-soluble radioactivity to the substitution solution, whereas leaf discs substituted in propylene oxide lost less than 1% of their water-soluble activity. The use of propylene oxide is therefore more satisfactory for freeze substitution when the retention of water-soluble compounds is desired.

(153)

Observations on the Growth and Regeneration of the Compound Eye of *Periplaneta Americana*

CORNELIA T. HYDE, *Georgia Southern College*

A growth zone surrounds the eye of the juvenile cockroach. The eye grows from instar to instar by the addition of ommatidia all around the perimeter of the eye, not from a single budding zone as has been reported for the Odonata. The ommatidia of the growth zone are progressively pigmented during the instar and are completely pigmented and presumably functional at the time of the succeeding ecdysis. Ommatidia produced at the posterior edge of the eye are larger and fewer in number than those from the anterior, ventral, and dorsal areas.

The eye will regenerate during juvenile life if only a few cells remain after surgery, but following removal of the entire eye, no eye regenerates. Transplantation of either juvenile or adult eye tissue to the head of a juvenile from which the eye has been removed results in the growth of a new eye.

(155)

A Numerical Evaluation of the Cells of the Corpora Lutea in Pseudopregnant and Pseudopregnant Bilaterally Enucleated Hamsters (*Mesocricetus auratus*) Waterhouse

JEROME R. HYMEL AND WILLIAM W. NORRIS, JR.
Northeast Louisiana State College

The weight and absolute cell numbers of developing hamster corpora lutea were measured at days 3, 5, 7, and 9 of pseudopregnancy in blinded and non-blinded hamsters. The corpora lutea of non-blinded animals increased from approximately 0.65 mg at day 3 to 0.97 mg at day 5, and declined to approximately 0.70 mg at day 9. The number of cells of the corpora lutea, the numbers of luteal and non-luteal cells increased from day 3 to day 5 and then declined through day 9. In blinded animals the weights of the corpora lutea declined from approximately 0.64 mg at day 3 to 0.37 mg on day 9. The number of luteal cells paralleled the changes observed in the luteal cells of the non-blinded group. This data supports the view that an active pineal gland brings about a decrease in the cellularity of the corpus luteum in pseudopregnancy.

(35)

Preliminary Studies on the Chemical Composition of Chelonians

CRAWFORD G. JACKSON, JR., CHARLIE M. HOLCOMB,
AND MARGUERITE M. JACKSON
Mississippi State College for Women

An investigation of the chemical composition of the tissues and body fluids of turtles was undertaken, with emphasis on the concentration of substances and their ratios to one another. Research thus far has dealt with the magnesium and calcium content of the aorta, iron concentration of the liver, and blood serum cholesterol. Calcium-magnesium ratios are relatively uniform, and the abundance of the two elements in aortic tissue is apparently unrelated to age. Concentration of liver iron was found to increase with age. Blood serum cholesterol levels are moderately variable and appear to show a slight correlation with age. Further work will deal with additional substances and will attempt to: (1) uncover differences in body chemical composition between different taxa and, (2) assess the influence of age, sex, diet, and mode of life.

(199)

The Effects of Fluctuating Temperatures on the Reproductive Potential of *Drosophila affinis*

WILLARD L. JINKS, *Marshall University*

In the continuing effort to understand the effects that ecological factors have upon the reproductive potential of *D. affinis*, the temperature of the fly's environment was permitted to fluctuate between 23.5°C for a daytime high to 18.5°C nighttime low. When the data of these experiments were compared to what is considered normal temperature of 21.1°C (70°F) for this fly, the fluctuating temperatures lowered the longevity of the fly from an average of 31.4 days to 20.6 days. The generation time remained constant at 14-15 days. The sex ratio changed from a ratio of 100 females to 100 males at 21.1°C to 250 females to 100 males by the end of the experimental period. Fecundity for the first twelve days of the experimental period was 5.1 eggs/female/day which decreased to 3.9 eggs/female/day and again increased to 6.7 eggs/female/day at the end of the period. Viability dropped from an average of 52.7 per cent to 22.1 per cent for the first twelve days of the experimental period and increased to 68.3 per cent at the end of the experiment.

(12)

The Influence of Sodium and Potassium on the Amino Acids of Cotton Leaves

H. E. JOHAM AND VIOLA ROWE
Texas A & M University

Cotton plants, *G. hirsutum* strain Stoneville 7A and *G. barbadense* strain Pima S2 were grown in complete Hoagland's solution. During the last 15 days of the experiment the plants were subjected to four nutrient treatments which were designated as: (1) (+K+NA), (2) (+K-NA), (3) (-K+NA), (4) (-K-NA). When the plants were 45 days old, the leaves were harvested, weighed and then frozen on dry ice. Total and free amino acids were determined using a Beckman 120B amino acid analyzer. Results indicate that the effect of potassium nutrition on the amino acid content of cotton leaves is conditioned by the substrate sodium

level. In Stoneville 7A, potassium deficiency was the main factor in controlling the free amino acid level, whereas in Pima S2, omission of either K or NA caused a marked increase in certain amino acids.

(227)

Prolonged Seling in *Hymenolepis microstoma* (Cestoidea, Cyclophyllidae, Hymenolepididae)

ARTHUR W. JONES, MAX R. PROFFITT, B. D. TAN
AND H. L. WARD

Department of Zoology and Entomology
The University of Tennessee at Knoxville

A single cysticeroid of *Hymenolepis microstoma*, the mouse bile duct tapeworm, was fed via stomach tube to an HA/ICR strain albino mouse. After 20 days gravid proglottids of the resulting adult worm (parental, or P generation) were fed to flour beetles, *Tribolium confusum*; 30 days later one F₁ cysticeroid from the beetles was fed to each of 10 mice. Gravid F₁ proglottids were subsequently recovered and fed to beetles as above. This procedure was repeated for 15 selfed generations without an apparent change in viability of either eggs or cysticeroids. The infection rate for 15 generations averaged 89%, varying from 80% to 100%. This rate approximated the 70-80% infection rate obtained from multiply-infected mice. The viability of selfed *H. microstoma* contrasts with that of selfed *H. nana*, as reported by earlier workers, and this difference may have evolutionary and immunological significance. (Supported in part by contract AT (40-1) 1749 with the U.S.A.E.C.)

(106)

Scanning Electron Microscopy in Systematics: *Vernonia* (Compositae) Pollen

SAM B. JONES, *The University of Georgia*

SEM micrographs resolve features of the pollen grain wall that cannot be accurately measured, or even seen well, with light microscopy. Except under the higher magnifications, the depth of the field often exceeds the radius of the pollen grain. The SEM also offers ease of specimen preparation and zoom magnifications. The net result is the opportunity for a new look at the surface sculpture of pollen. It is generally only between the broader groups of plants that differences in pollen grain characteristics are sufficiently marked to be usable in systematics. *Vernonia*, with around 1,000 species, is a notable exception. The pollen grains of *Vernonia* are sufficiently complex to permit variation in the surface sculpture so that some species may be distinguished from each other. In addition, it may be possible to obtain systematic evidence from the pollen micrographs. This evidence is badly needed in this large and complex genus.

(3)

A Diurnal Relationship Between Leaf-water Potential and Relative Turgidity or Stem Diameter of Cotton

WAYNE R. JORDAN AND JOE T. RITCHIE
Texas A&M University and USDA-ARS, Temple, Texas

Changes in the water balance of cotton during a 24 hour period were studied under field conditions. Leaf-

water potential changed more rapidly in response to the daily atmospheric demand cycle than either relative turgidity or stem diameter. The observation that these changes in water content lagged behind water potential lead to an interesting relationship between these two parameters. A closed-loop hysteresis curve resulted when either relative turgidity or stem diameter was plotted against leaf-water potential at hourly intervals throughout an entire day. Thus, single relative turgidity values correspond to double values of leaf-water potential differing by as much as 7-8 bars depending upon whether the value lies on the absorption or desorption portion of the hysteresis loop. In like manner, single potential values correspond to double relative turgidity values differing by as much as 5 percent. Changes in stem diameter, determined with a linear variable displacement transducer, followed closely the diurnal pattern observed for relative turgidity. On the basis of these results, methods based on changes in water content such as relative turgidity and stem diameter cannot be used directly to estimate water potentials unless the hysteresis relation is known or carefully considered.

Research supported in part by a grant from the Cotton Producers Institute and the National Cotton Council of America.

(37)

The Effects of Synthetic Juvenile Hormone on Larval Development of the Blowfly, *Phormia regina* (Insecta: Diptera)

R. B. JUBENVILLE AND L. T. WIMER
University of South Carolina

Effects of synthetic juvenile hormone (SJH) on certain aspects of larval development of *Phormia regina* were investigated by injecting 100 ug of SJH (in sesame oil) into early third-instar larvae. Three controls were used: mock injections, insect Ringer injections, sesame oil injections (injection volume - 1 ul). A marked delay in puparium formation (pupariation) was the first observed effect in SJH-injected animals. Only one of 100 larvae injected with SJH completed metamorphosis. The SJH-injected animals, when compared with controls, were heavier and had a larger fat body containing more lipid. Dissection of insects injected with lipid revealed a lipid spherule present in the hemolymph at pupariation, indicating that some injected lipid was retained in the hemolymph during third-instar development. The amount of injected lipid metabolized to CO₂ during larval development was ascertained by assaying the C¹⁴O₂ produced following the injection of C¹⁴-labelled triolein.

(85)

The Use of Assessment Lines to Estimate Area Affected by Small Mammal Removal Trapping

DONALD W. KAUFMAN,
*Savannah River Ecology Laboratory
University of Georgia*

Two sets of snap trap lines were set in the lowland mesic-hardwood forest on the Atomic Energy Commission's Savannah River Plant near Aiken, South Carolina during the winter, 1969. Traps were set on eight census lines, each with 16 trap stations, forming an octagon-shaped trap line. Traps were subsequently set on eight assessment lines with each assessment line crossing a corresponding census line. Area of effect due to removal of small mammals by census lines was calculated

from captures on the assessment lines. The number of small mammals in the area of effect was estimated using numbers removed by census lines multiplied by an estimate of the proportion of the animals removed from the area of effect. Densities estimates were 2.8 *Peromyscus gossypinus*/ha, 3.8 *Ochrotomys nuttalli*/ha and 1.3 *Blarina brevicauda*/ha.

(34)

Isozyme Polymorphism in Southeastern Populations of the Harvester Ant, *Pogonomyrmex badius*

R. ELIZABETH KENT AND F. M. JOHNSON
North Carolina State University

Populations of harvester ants, *Pogonomyrmex badius*, were sampled in Florida, Georgia, South Carolina and North Carolina. Five polymorphic loci with enzymatic functions were separated by electrophoresis. Phenotypic, genotypic and allelic frequencies were determined for all loci in all populations. The action of ecological factors on these loci will be discussed.

(18)

Regulation of Dormancy in Peanut Seeds

D. L. KETRING AND P. W. MORGAN
Crops Research Division, USDA-ARS and Department of Plant Sciences, Texas A & M University

Germination tests with ethylene showed that this gas was effective in breaking dormancy of Virginia-type peanut seeds. Indole-3-acetic acid and abscisic acid did not stimulate ethylene production by, or germination of, the dormant seeds while gibberellic acid and coumarin had only a slight promotive effect. Kinetin and ethylene gas stimulated both ethylene production and germination of the seeds. A comparison between the effects of ethylene treatments on the less dormant apical seeds and the more dormant basal seeds showed that the basal seeds could be induced to germinate to the same extent as the apical seeds by 7 or 8 ppm ethylene. Ethylene gas produced the greatest germination at low concentrations and it appears most directly related to initiating the reactions for converting the quiescent cells to an active state of growth. During "after-ripening" in storage at 3° there is a gradual decline in dormancy and increase in ethylene production; therefore, ethylene appears to be involved in the natural regulation of dormancy of these seeds.

(27)

A Polygraph Technique for Determining the Relative Toxicities of Various Chemical Agents

T. DANIEL KIMBROUGH AND J. MILES SHARPLEY
Virginia Commonwealth University

Arsenobenzene (ASB), phenylmercuric acetate (PMA) and dodecylguanidine (DG) were used during a test which employed the polygraph to measure tissue sensitivity to toxic compounds. Strips of rat duodenum were perfused in a constant temperature bath. Then responses to added chemicals were obtained by using a 1.5 oz. strain gauge connected to a polygraph. Gut motility was quantitated in cm²/min. with a polar planimeter. The earliest inhibition of motility was observed following the addition of 0.1 ppm (parts/million) of ASB. Total arrest of motility by this agent occurred at 3 ppm. With PMA, however, inhibition of motility

was not observed until a concentration of 10 ppm was obtained. Total arrest occurred at 25 ppm. DG had little or no measurable effect on gut motility even when the concentration reached 100 ppm.

(229)

Thermal Pollution in Biscayne Bay: Some Implications for the Future

RICHARD W. KLUKAS, *Everglades National Park*

Abstract: In the early fall of 1968 it was found that the Florida Power and Light Company was emitting thermally polluted waters into South Biscayne Bay in Dade County, Florida. Subsequent investigations determined that heated waters were recirculating through the plant's cooling system and that biological damage was occurring in offshore areas. The seriousness of this situation was heightened by the fact that most of South Biscayne Bay is within the boundaries of the Biscayne National Monument. In view of these factors, Florida Power and Light has proposed a plan that supposedly would accommodate the heated effluents from the two fossil fuel units now in operation and from the two nuclear units due for activation in 1971 and '72. This proposal calls for the construction of a discharge canal that would terminate in Card Sound some six miles to the south. Many local and National interests feel that there are too many uncertainties inherent in the plan and that the thermal pollution problem is merely being moved to another area. For this reason the issue can be expected to receive increasing National attention. No matter what the outcome, however, power generating facilities in Dade County (now operating or under construction) will not be sufficient to provide for the projected demands of the late 1970's. New conflicts can be expected as additional large scale generating facilities are proposed to meet these demands. Such conflicts could be minimized or entirely avoided with an approach that has received little if any attention. Referred to is a plan that would entail: a system of small, widely dispersed generating facilities; the judicious use and/or rationing of power; and the application of natural principles in regulating or modifying temperature conditions in homes and other buildings. A rather radical change in political and economical thinking would necessarily have to precede such an approach.

(177)

The Ultrastructure of Mycorrhizal Protocorm Development in *Epidendrum conopseum* (Orchidaceae)

ROBERT KNAUFF AND H. C. ALDRICH
University of Florida

In nature all orchids require the presence of an endophytic fungus for seed germination, protocorm growth, and early seedling development. The developing orchid derives essential factors for its nutrition from the fungal symbiont while controlling the growth and spread of the fungal infection within its cells. The cellular morphology of the symbiotic protocorm has been examined, noting vesicular transport between the orchid and the endophyte, cellular secretion by the orchid, penetration of the orchid cell wall by the fungus, and digestion of the fungus by orchid cells. The intracellular hyphae proliferated within an orchid cell, formed coils of hyphae which were filled with electron dense material, and then began to hypertrophy. Eventually the orchid cell contained a large mass of empty hyphal walls packed into the center of the cell.

(167)

Preliminary Studies on Lipid Class and Fatty Acid Composition in the Colonial Rotifer *Sinantherina semibullata* Thorpe

LUTHER A. KNIGHT, JR., *University of Mississippi* AND
THOMAS M. SMITH, *University of Mississippi School of Medicine*

The lipid class and fatty acid chain length composition of the colonial rotifer *Sinantherina semibullata* Thorpe has been investigated by thin-layer and gas-liquid chromatography. Major lipid classes were free sterol and phospholipid (polar lipid) and minor lipid classes were free fatty acid, triglyceride and sterol ester. Larger amounts of total lipid were found in rotifers collected in sunlit areas than in those collected from the bank areas of a shaded captured pond. Fatty acid chain lengths from less than 14 carbons through at least 28 carbons were found. A variety of branched chain fatty acids were also present in the total lipid. The lipid constitution of this rotifer is compared to that of selected helminths and plankters.

(9)

Organic Acid Changes During Ion Uptake by Young Cotton Roots

DANIEL R. KREIG AND H. E. JOHAM
Texas A & M University

A study was made of the changes in the organic acid fraction of young cotton roots during periods of ion uptake. When $10^{-3}M$ K_2SO_4 was used as the test solution, malic acid increased and tartaric acid decreased. Using $10^{-3}M$ Na_2SO_4 , citric acid increased and malic acid decreased in relation to Na^+ accumulation. The hypothesis is advanced that various organic acids exhibit a certain degree of selectivity for various inorganic cations. Whenever single salt solutions are used from which differential ion accumulation occurs, various organic acids will increase in concentration depending on the stability of the complex formed.

(230)

The Use of a Simple Staining Technique on Diatom Populations as a Possible Indicator of Thermal Pollution

GUY R. LANZA, JOHN CAIRNS, JR.,
AND KENNETH L. DICKSON
Virginia Polytechnic Institute

Several staining techniques have been surveyed as possible indicators of the physiological effects of thermal pollution upon cultured aquatic diatoms as well as on naturally occurring communities. Of these, initial laboratory trials employing 3,4-Benzpyrene-Caffeine Fluorescent Stain (Berg, N. O. 1951. A Histological Study of Marked Lipids. Stainability, distribution, and functional variations. *Acta Pathol. Microbiol. Scand. Suppl.* 90:1-192.) on the cellular lipids and sterols of fresh-water diatoms has met with the highest degree of success. Axenic populations of *Navicula pelliculosa* and *N. seminuham* were grown under controlled laboratory conditions. Following abrupt temperature increases of 60 degrees Centigrade above ambient for two hours, and 20 degrees Centigrade above ambient for twenty-four hours, there was a decrease in cellular fluorescence under the ultra-violet microscope. The response of

mixed natural communities is under study with the ultimate goal of developing a simple analytical technique for the assessment of certain physiological effects of thermal pollution upon aquatic populations. (Research Supported by Water Resources Research Grant BO17-VA.)

(213)

Who Lives with You?

Introduction by FELIX H. LAUTER,
Department of Biology, University of South Carolina

A 9-minute 16 mm-sound-color live action and animation film produced by the University of South Carolina and S. C. ETV Network. This is an educational movie depicting the life cycle of the human intestinal parasite *Ascaris lumbricoides*. Emphasis throughout is placed on the importance of good health habits and personal hygiene. Through cartoon animation and microscope photography the life cycle of the parasitic round-worm, "Carrie" *Ascaris* is portrayed in story form. Live action sequences show how an individual becomes infected. The film then demonstrates measures necessary to combat infection and to prevent reinfection. Finally, the film stresses the program of drug treatment needed to rid the human body of intestinal worms.

(47)

The Geographic and Ecological Distribution of the Florida Scrub Lizard, *Sceloporus woodi* Stejneger

DAVID S. LEE, *Natural History Society of Maryland*
AND JOHN B. FUNDERBURG, *Florida Southern College*

Recent field observations by the authors indicate that *Sceloporus woodi* (Class Reptilia: Order Squamata) is more geographically limited in its distribution than previously believed. The geographic distribution of the scrub lizard appears to be limited to four major areas: 1) the Ocala "Island," 2) the Lake Wales Ridge, 3) Atlantic dune scrubs, and 4) the Collier County scrub. These populations are ecologically isolated and gene flow between them is unlikely. Although past literature implies that this species is confined to the rosemary-scrub community, colonies have been found in scrub ecotone, sandhill and citrus grove habitats.

(21)

Involvement of Ethylene in Dehiscence of Fruit

JOHN A. LIPE AND PAGE W. MORGAN,
Texas A & M University

Ethylene production by detached flowers and bolls of field-grown cotton was measured periodically from bloom until the completion of dehiscence. Approximately 3 ul ethylene/kg fresh weight/hr was evolved during the first 4 days after bloom—shortly before and coinciding with the period of young fruit abscission. Subsequently, ethylene production dropped to well below 1 ul/kg/hr until about one week before the initiation of boll dehiscence. Peak ethylene evolution of almost 7 ul/kg/hr was reached approximately one week before maximum boll dehiscence. Ethylene evolution by detached pecan fruit followed a similar pattern. Less than 1 ul ethylene/kg fresh weight/hr was produced from mid-season until approximately one week before the initiation of perianth dehiscence, when a maximum of almost 20 ul/kg/hr was attained. Since exogenous ethy-

lene has been shown to stimulate husk dehiscence of walnuts, the present results suggest that ethylene may be a hormonal regulator of dehiscence of some fruits.

(174)

The Vegetative Anatomy of *Phryma leptostachya* L.

HARRIET LIPSCOMB, *Georgia College*

The vegetative anatomy of *Phryma leptostachya* L. was examined to help evaluate its systematic position. Seedling anatomy revealed a diarch root condition with a short transition zone below the attachment of the cotyledons. The perennating system produces one plantlet each year. The swollen portion of the rhizome of the current years plant is connected to the persistent rhizome of the previous years plant by a thinner portion of the rhizome.

The anatomy of the stem follows the general pattern for herbaceous members of Lamiaceae and Verbenaceae with four major vascular strands, one in each corner. Anatomically, the swollen internodal portion of the stem, a diagnostic character of *Phryma*, results from enlarged pith and cortical cells. Leaf anatomy conforms to the general mesophytic broad leaf pattern with stomatal development being of the "ranunculaceous" type. Vegetatively *Phryma* is very similar to both the herbaceous Verbenaceae and Limniaceae.

(26)

Toxicological Responses of Syrian Hamsters, *Mesocricetus auratus*, to Chronic Feeding of Purified Aflatoxin B₁

GERALD C. LLEWELLYN

Virginia Commonwealth University, Richmond, Virginia
AND

WARREN G. HANSEN, *Bionucleonics Department,*
Purdue University, Lafayette, Indiana

Current studies with aflatoxin B₁ indicate that it inhibits the rate of weight gain, especially in young swine. These studies are complemented by other reports that this carcinogen also interferes with protein synthesis in the liver.

Weanling, male Syrian Hamsters were fed 1 ppm aflatoxin B₁ in their diet for periods up to 259 days. The results from this work indicated that there was an inhibition in the mean gain in mean animal weight in the Aflatoxin Groups when compared to the Control Groups on day 98, 161, 210 and 259.

The liver pathology observed in the Aflatoxin B₁ Groups included hypertrophied hepatocytes with enlarged nuclei and some nuclear inclusions. The severity of these lesions increased with time. No hepatomas were observed but bile duct congestion did occur in groups of animals exposed for 210 and 259 days.

(211)

Flora of Tropical Florida

ROBERT W. LONG AND OLGA LAKELA
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Tropical Florida is defined as the southernmost tip of the peninsula, and it includes Collier, Dade, and Monroe counties. The tropical flora occupies roughly a "U" shaped area south of Lake Okeechobee. It has not been treated taxonomically in whole or in part since Small's

Manual of the Flora of Southeastern U.S., 1933. It has been our primary objective to produce a book that will be useful not only to professional and amateur botanists and naturalists, but also to the general public as well. The book, which will be published this year, includes the wild and naturalized ferns and seed plants of the area. In addition to diagnostic keys, information is provided regarding the characteristics of the plants, their habitat and general ecological associations, distribution, chromosome number (if known), and pertinent synonymy. The flora of tropical Florida is composed of 177 families, 760 genera, and 1,647 species. About 65% of the flora is herbaceous, and 60% of the species is generally tropical in distribution. Approximately 10% of the flora is endemic to Florida.

(119)

A Histochemical Study on the Intestinal Epithelium of *Rhabdias ranae*, Walton 1929 (Nematoda: Rhabditida)

LEONARD E. LUNDQUIST, *Lander College*

A previous study, by the author, at the ultrastructural level, has revealed the presence of an external homogeneous coat covering the microvilli of this nematode's intestinal epithelium. The coating is not indigenous to only the epithelial cells of this particular nematode. From literature surveys the consensus is that this coating is mucopolysaccharidal in nature. In this study several histochemical tests, including the Periodic Acid-Schiff test, are being conducted to determine the histochemical makeup of this coat. In addition, glycogen determining tests are being made in an attempt to support previous observations, at the ultrastructural level, of apparent glycogen deposits within these cells.

(166)

Effects of Temperature and Photoperiod on Seasonal Development of *Tetragoneuria* *cynosura* Larvae (Insecta: Odonata)

PAUL E. LUTZ, *University of North Carolina*
at Greensboro

Late instar larvae of *Tetragoneuria cynosura*, collected in Guilford Co., N.C. from October, 1965 until November, 1966 and from August-October, 1969, were maintained at 11-hr, 14-hr, or natural photoperiods and at natural, 15°, 20°, 25°, or 30°C temperatures. Animals collected from October until March responded faster to 14-hr daylengths than to 11-hr photoperiods. Both experimental daylength groups developed faster than animals at natural conditions. For larvae collected from June until September, however, an opposite response occurred with 14-hr animals exhibiting great growth retardation. Corresponding short-day animals responded similarly to larvae maintained in nature. The reversal in response occurred shortly after the autumnal equinox. At both photoperiods, temperatures of 20°C accelerated growth compared to that at 15°C, but temperatures of 25 and 30°C tended to slow development. Responses of larvae in later instars were studied to ascertain those developmental stages most affected by the photoperiodic-temperature conditions.

(14)

Kinetic Studies of Rubidium Transport to the Shoots of *Zea mays*

SILVIA DIANA MATTEUCCI, *Duke University*

The aim of this research is to determine the effect of water flow on salt transport to the shoots of 10-12 day-old corn seedlings. The technique used is a kinetic analysis of ion transport from solutions of radioactive rubidium ranging in concentration from 0.01 to 0.2 mM. Potassium is used as a specific inhibitor of Rb uptake. Comparisons are made between transpiring and non-transpiring plants. Increase in water flow produces a marked increase in salt transport to the shoot. However, in the presence of potassium there is no significant difference between transpiring and non-transpiring plants with respect to the amount of Rb transported to the shoots. It is concluded that, in this low concentration range the increased transport of Rb to shoots accompanying increased water flow is not due to mass movement of ions in the transpiration stream.

(69)

A Half Century of Succession in an Appalachian Forest Following the Chestnut Blight

J. FRANK McCORMICK, *University of North Carolina*
ROBERT B. PLATT, *Emory University*

Prior to the chestnut blight about 1920, the upper slope (~1050M) of Beanfield Mountain, Giles County, Virginia, was dominated by *Quercus borealis*, *Quercus alba*, and *Castanea dentata*. Fifty years later, the most important species are *Carya glabra* and *Quercus alba*. The middle (~900M) of this south facing slope was dominated by *Quercus prinus* and *Castanea*. *Carya* has now replaced *Castanea* as a co-dominate species. The lower slope (~800M) has changed from a *Castanea-Quercus alba* forest to one dominated by *Carya* and *Acer saccharum*. A cove forest containing *Castanea*, *Fraxinus americana*, *Tilia americana*, *Aesculus octandra* and other mesic species has persisted in coves below 700M and in higher ravines, except for the loss of *Castanea*.

Throughout Beanfield Mountain *Castanea* has been replaced by *Carya*; there has been an extensive invasion by *Acer rubrum*; and there has been a reduction in *Quercus borealis*. The previous observation that *Carya* increases in importance with latitude as a replacement for *Castanea* is substantiated by this study.

(216)

Observations on an Undescribed Species of Tapeworm Obtained from Cysticerci from the Cotton Rat, *Sigmodon hispidus*

STURGIS McKEEVER AND HERBERT M. HENRY
Georgia Southern College

Cotton rats which were collected near Statesboro, Georgia had cysticerci of an unknown species of tapeworm in their liver and lungs. Cysticerci were fed to pups, kittens and baby chicks. Adult worms which were obtained from two pups represent an undescribed species of *Cladotaenia*.

(205)

On the Genus *Axinandra* Thwaites and The Taxonomic Position of Rhizophoraceae

WILLEM MEIJER

The rediscovery of the genus *Axinandra* in the forests of Sarawak and Sabah (North Borneo) during the last 10 years has initiated a study of its taxonomic position and shown that it is a missing link between the families Melastomataceae, Lythraceae, Myrtaceae and Rhizophoraceae in the order Myrtales and Crypteroniaceae in the Saxifragales (Takhtajan 1969). Evidence is given that *Axinandra* is a primitive Melastomataceae. Its area, including Ceylon, Malaya and Borneo points to its origin during the Cretaceous before Ceylon was separated from Malesia. The structure of its flowers and capsular fruits with winged seeds bring it very close to the Madagascarean genus *Macarisia* in Rhizophoraceae. The same fruit structure occurs in *Lagerstroemia* (Lythraceae) and *Crypteronia* (Crypteroniaceae). Remarkable resemblances occur also in the structure of the stamens. It can be argued that *Axinandra* and *Macarisia* belong to the primitive stock of Myrtales. The Rhizophoraceae belong distinctly within this relationship and not in the Cornales as done by Cronquist (1968). Though the Melastomataceae got their greatest development in the American tropics, their origin must be sought somewhere in the African-Asiatic area near the cradle of the Angiosperms (Takhtajan 1969). The mangrove genera of the Rhizophoraceae are a group derived from the more primitive *Macarisia*-relationship (Takhtajan 1959).

(5)

Use of Polyethylene Glycol with Divided Root Systems to Measure Root Resistance

BURLYN E. MICHEL, *University of Georgia*

Corn (*Zea mays*) and soybean (*Glycine max*) were grown with root systems divided between adjacent 1 quart polyethylene freezer cartons containing nutrient solution. By adding polyethylene glycol (Carbowax 6000) to reduce solute potential until water absorption from that side stopped, the root xylem water potential could be ascertained. Using absorption rate as a measure of flow, root system resistance could be calculated. Corn root systems had higher resistances and developed lower water potentials than soybean. By projecting expected water flow rates for the growing plants, it was possible to estimate the decreasing resistances of the growing root systems and determine the effect on root resistance of treatment with polyethylene glycol at concentrations too low to stop water absorption. Such treatment increased the resistance of roots to water movement.

(15)

Involvement of Ethylene in Picloram-Induced Leaf Movement Inhibition

PAGE W. MORGAN AND J. R. BAUR,
Texas A & M University

The proposed role of ethylene synthesis in picloram (4-amino-3,5,6-trichloropicolinic acid)-induced inhibition of leaf movement in mesquite and huisache seedlings (Plant Physiology 44:831-838, 1969) is supported by the present findings. Threshold levels of exogenous ethylene and root-applied picloram required to block the

light or mechanically induced movement of leaflets were found to be lower in huisache than in mesquite. The leaf movement response was more sensitive to concentration changes of picloram in mesquite and ethylene in huisache. Internal ethylene levels in huisache and mesquite seedlings treated with 1 and 10 ppm picloram, respectively, were measured. The values 48 hours after treatment, similar to those determined by indirect means previously, were 2.3 and 4.7 ppm ethylene for huisache and mesquite, respectively. These ethylene levels within picloram-treated plants are far in excess of those necessary to block leaf movement.

(97)

One Rediscovered and One New Hybrid of *Solidago bicolor* L.

GARY H. MORTON, *University of Tennessee*

Fernald, in Gray's Manual (1950), enumerated 37 hybrids within the section *Virgaurea* of *Solidago*, but overlooked an obvious hybrid, *S. x alexanderi*, found in Vermont and published by Harold N. Moldenke thirteen years earlier. The parents of *S. x alexanderi* were proposed as *S. bicolor* times either *S. gigantea* Ait. or *S. canadensis* L. A hybrid, recently collected in West Virginia, that fits the description of *S. x alexanderi* was compared to the type with which it did not fit. From this and other studies, it is suggested that the parents of the hybrid named by Moldenke are *S. bicolor* and *S. gigantea* and the parents of the recently collected hybrid are *S. bicolor* and *S. canadensis*.

(101)

Evidence for the Existence of Tetraploid *Coreopsis delphinifolia* Lam. (Angiospermae: Asterales: Compositae)

ANNA M. MUELLER, *University of North Carolina at Chapel Hill and North Carolina Central University*

There is good evidence that *Coreopsis major* Walt., distributed from Kentucky and South Carolina southward, and *Coreopsis verticillata* L., which occurs mainly in Virginia and North Carolina, have formed an allotetraploid at some time in the past. The existence of this allotetraploid is postulated because of the current presence of an autoallooctoploid in the coastal plain of Georgia and South Carolina that apparently was formed by the doubling of an ancestral allotetraploid. Artificial diploid hybrids between *Coreopsis major* and *Coreopsis verticillata* are morphologically identical to the existing autoallooctoploid. Furthermore, there are two hexaploids probably formed when the original allotetraploid backcrossed to its parents forming two triploids. These then doubled to form the hexaploids with the genomic constitution MMMVVV, occurring mainly in the piedmont of Georgia, and MMVVVV, limited to south central South Carolina. The present distribution indicates that the ancestral allotetraploid ranged in the area that is now South Carolina.

(233)

Six Months Comparison of Plankton, Fish, and Chemistry from the Chesapeake Bay Adjacent to the Proposed Nuclear Power Plant at Calvert Cliffs, Maryland

RICHARD A. MULFORD, *Benedict Estuarine Laboratory, Academy of Natural Sciences*

As part of a larger series of studies, monthly samples of surface and bottom plankton, chemical analyses, and fish trawl samples are compared in order to determine normal baseline populations prior to the operation of a nuclear power plant. Generally, plankton counts indicated a rather normal population curve for the sample period, while supplementary chemical and fish data provided numbers relating to an over-all picture of the ecology of the environment. (Research supported by The Baltimore Gas and Electric Company.)

(140)

Preliminary Studies of Lipid Classes from Several Pollen Species by Thin-Layer Chromatography

GERALD W. NAYLOR, *Carson-Newman College*

Total lipids from several pollen species were extracted in a microsoxhlet with chloroform-methanol (2:1, v/v) according to Folch, *et al.* TLC plates were prepared of Silica Gel G (30 g + 65 ml H₂O) on a Desaga apparatus, air-dried for 1 hour, and oven-activated for 1 hour at 120°C. Samples were eluted 3 times with chloroform-methanol (2:1, v/v) to a point 3 cm in hexane-diethyl ether-acetic acid (80:20:1.5, v/v/v). The separations, visualized either by charring or by spraying with stains, showed a dense band in the phospholipid zone for *Parkinsonia aculeata* and *Passiflora incarnata*. While both were weak in triglycerides, *Agave americana* had a very dense band; *Parkinsonia* showed dense monoglyceride and diglyceride bands. *Impatiens pallida* had an extra band in the triglyceride zone not seen in *Impatiens biflora*, and *Petunia hybrida* exhibited a hydrocarbon band not found in the other species.

(100)

Distribution and Ploidy Levels in *Erigeron flagellaris* Gray

GUY L. NESOM, *Stratford College*

Erigeron flagellaris is found primarily in the southwestern states of N.M., Colo., Ariz., and Utah. The distribution of diploid populations of this species appears to be of a relictual nature, with diploid centers being confined to three small areas, one each in Arizona, New Mexico, and Colorado. The remainder of the range of *E. flagellaris* is occupied by polyploid plants from triploid to hexaploid in level. These occur at lower elevation than the diploids and are probably agamospermous. Triploids and tetraploids are found throughout the range of the species; pentaploids and hexaploids are found only in the Utah-Arizona area. Most of the polyploid populations are suspected of having arisen through autopolyploidy, though hybridization with another species is a possible mechanism, especially in the range of the pentaploids and hexaploids. Thus, the spread of *E. flagellaris* from the relictual diploid centers is probably due to widened tolerances of the apomictic autopolyploids and possibly to introgression of genes from another species of lower altitudes.

(50)

Studies of Fishes in Western North Carolina (Teleostomi: Osteichthyes: Cypriniformes: Cyprinidae)

L. M. OUTTEN, *Mars Hill College*

During the period from September, 1949, to November, 1969, two hundred and twenty collections of fishes were made in some thirty tributaries of the upper Tennessee River system in the western North Carolina area. Studies of the more than thirty species found were made at the stream habitats and in the laboratory. Detailed life history studies were made for four of the species, *Notropis coccogenis*, *N. galacturus*, *N. leuciodus*, and *N. rubricroceus*.

(6)

An Explanation for the Stomatal Response of Excised Leaves to Kinetin¹

J. E. PALLAS, JR. AND J. E. BOX, JR.²

Cytokinins stimulate transpiration of barley, excised oat, rye, and wheat leaves. Transpiration increases are correlated with increased stomatal apertures, and thus a decrease in stomatal resistance, after cytokinin treatment. These investigations indicate the stomatal response mechanism of kinetin-treated leaves.

Psychrometric and porometric determinations were made on excised oat leaves treated with and without kinetin. Kinetin-treated leaves had more negative total leaf water potentials (0.4-2.5 bars) than did nontreated leaves. However, the osmotic water potential in kinetin-treated leaves was always less negative (1-5 bars) than that of the nontreated leaves. Diffusion resistances were always less with kinetin-treated leaves whether in light or dark.

Stomatal opening of kinetin-treated leaves probably results from kinetin's maintaining or stimulating protein synthesis via RNA synthesis. Protein synthesis in the exercised leaf lowers the concentration of those compounds that are normally osmotically active. The lowering of osmotic potential effectively lowers the turgor pressure of leaf cells other than guard cells. This results in a net osmotic advantage of guard cells and causes osmo- and turgorpassive stomatal opening.

¹Contribution from the Southern Branch, Soil and Water Conservation Research Division, Agricultural Research Service, USDA; in cooperation with the University of Georgia Agricultural Experiment Stations, for presentation at meeting of the Association of Southeastern Biologists, Lakeland, Florida, April 2-4, 1970.

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(104)

The Influence of Environment on Petal Flavonoids in Four Species of *Gossypium* L.

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and County Arboretum*

A plot including seventeen lines from four species of *Gossypium* was grown at five different localities including desert and coastal California, central Texas, piedmont North Carolina and a greenhouse. Petals were

collected, dried, and extracted in a uniform manner for a chromatographic survey of constituent flavonoids. Pigment extracts were studied by the methods of column and paper chromatography. Comparison of paper chromatograms developed from crude extracts of the same line grown at different localities showed virtually no qualitative pigment variation. A more sensitive analysis involving column and paper chromatography showed many additional minor pigment constituents in these plants, but even these minor constituents showed very little qualitative variation when collections of the same genetic line grown at the five different localities were compared. The chemotaxonomic implications of the results of this study are discussed.

(61)

Airborne Algae of the Gainesville Area

ROLANDO T. PARRONDO, *University of Florida*

Airborne algae were recovered from the air over the Gainesville area and isolated into unialgal cultures by using 4 sampling methods: (a) hand-held plates from a moving automobile, (b) rain water used as an inoculum, (c) a sedimentation method, in which algae were collected by exposing nutrient agar to the atmosphere, and (d) by a Rotorod sampler device. Species collected were cultured in a modified Bristol's medium, in liquid state or solidified with agar. Thirty-six different species were identified from 431 unialgal isolates. Twenty-three species were members of the Chlorophyta, and 13 belonged to the Cyanophyta. The most common species were *Schizothrix calcicola*, *Chlorella* sp. and *Oocystis* sp.

Dry weather conditions favored an increase in the number of algal impactions on solid media. Afternoon samples collected with the Rotorod sampler showed consistently higher number of impactions than those collected during the morning hours. Partly cloudy skies produced a higher algal content in the air than did clear sky conditions. A wind speed of 15 mph favored an increase in the number of impactions on solid media.

(4)

Water Relations of Developing *Phaseolus vulgaris* Seeds

LAWRENCE R. PARSONS, *Duke University*

Water potential, and solute and matric potential were measured in developing bean seeds (*Phaseolus vulgaris* cv. Bountiful). Dry weight and fresh weight of the seeds were also recorded. Water potential fluctuated between -2 and -6 bars during the first 40 days after pollination, then dropped suddenly after the fortieth day. Solute potential combined with matric potential varied between -8 and -10 bars in young seeds. After the 25th day, solute plus matric potential decreased rapidly, reached a low sloping plateau, then dropped steeply again. Solute potential may be the dominant factor affecting water potential in the young seeds but matric potential appears to be the major factor in seeds older than 25 days. Turgor pressure is also important, especially in seeds older than 30 days. A correlation between water relations and certain growth regulators is considered possible.

(23)

Embryo Expansion without Endosperm Rupture in Lettuce Seed "Germination"

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National Laboratory, Oak Ridge, Tenn.

Sodium dichloro-s-triazinetriene or hypochlorite, both of which produce chlorine in aqueous solutions, permit considerable embryo expansion without endosperm rupture in lettuce seeds. The expansion of the embryo plus the mechanical restraint of the endosperm cause the embryo to buckle. No such abnormalities are seen in similar experiments in which seeds are cut so as to remove all mechanical restraint of the endosperm. In the intact, treated seeds the expanding embryo occasionally does cause endosperm rupture. When this occurs, however, the rupture is seldom near the micropylar end as in normal germination. We suggest that these two compounds interfere with a chemical endosperm-weakening that normally facilitates radicle protrusion. These findings provide evidence for the separation of mechanisms initiating embryo expansion from other physiological means of endosperm-weakening. (Research sponsored by the U. S. Atomic Energy Commission under contract with the Union Carbide Corporation.)

(113)

The Mechanism of Canavanine Resistance in *Escherichia Coli*

CECIL W. PAYTON AND LUTHER S. WILLIAMS
Atlanta University

In this study, the regulation of synthesis of the arginine biosynthetic enzymes was examined in a canavanine resistant mutant, which possessed a defective arginyl-tRNA synthetase. The activity of this enzyme in the mutant was found to be about 50% of that of the wild type strain. Further data indicate that the activity of the synthetase of the mutant lost about 40% of its activity on storage for 10 days at 4°C. Repression of the arginine biosynthetic enzymes by arginine was determined by the rate of formation of ornithine transcarbamylase. This activity was repressible by arginine in the wild type strain, but arginine had no repressive effects on the same enzyme in the canavanine resistant mutant. In addition, the *in vivo* charging of arginine to arginine tRNA was determined in both wild type and the mutant cells and correlated with growth under repressive and derepressive conditions and the activity of the cognate synthetase activity in the respective cells.

(22)

Controlled Atmosphere Storage of Fruit in Separate Film Packs

TARCOSIO PEREIRA AND H. M. VINES, *Univ. of Georgia*

Individual apples and tomatoes were enclosed in separate 1.5 mil polyethylene bags and stored at ambient temperature of 77° F. Concentrations of CO₂, O₂ and N₂ were determined with the aid of gas chromatography.

Box size polyethylene envelopes for pears and citrus have been used but the CO₂ build up and O₂ depletion have spelled disaster at ambient temperatures. Since the respiration rate of a given species is relatively constant, the amount of film surface per fruit can be in-

creased. Therefore polyethylene bags with a surface of 380 cm² were used to enclose separate fruit of about 160 gms. The CO₂ concentration was 3.0% and O₂ was 10-12% within 24 hours, and over an eight week period a slow change to 2.0% CO₂ and 16% O₂ was reached. Relative humidity remained near 100%.

Control fruit remained marketable for 7-10 days with shriveling and mealiness being the terminating factors. Bagged fruit remained firm and marketable beyond the 56 days of the experimental period and no adverse effect on flavor could be detected. Isolation of the small percentage of decayed fruit was also a distinct advantage.

(203)

Biosystematic Studies in *Sabatia* (Gentianaceae)

JAMES D. PERRY, *Univ. of North Carolina at Asheville*

Sabatia is a small, herbaceous genus of 17 species and two varieties. All species have been collected and grown for cytological and crossing studies. Field and greenhouse observations have shown that the breeding system is predominantly one of allogamy, enforced by protandry and spatial isolation of the androecium and gynoecium. No self-incompatibility exists. Chromosome counts reveal a wide array of numbers in the genus: n=13, 14, 16, 17, 18, 19, 20, 32, and 38. While natural hybridization has never been recorded, over 4400 artificial pollinations resulted in a number of vigorous hybrids. Sterility barriers to back-crossing or formation of advanced generation hybrids are stringent. The species of *Sabatia* undoubtedly are discrete phyletic units having chromosomal and genetic differences. Their arrangement in a systematic hierarchy is re-evaluated.

(75)

Distribution of ¹³⁷Cs in a Tagged *Liriodendron Tulipifera* Forest

LARRY N. PETERS

Radiation Ecology Section, Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

A long-term tracer experiment was initiated May 20-23, 1962 in a tulip poplar (*Liriodendron tulipifera*) forest located on the AEC Reservation, Oak Ridge, Tennessee. A 500-M² area of the forest was tagged with 467 millicuries of ¹³⁷Cs, introduced into the tree boles. Since the tagging, soil radioactivity has continued to increase. Main paths of transfer of ¹³⁷Cs from tagged trees have been rain leaching, litter fall and passage through roots. Including dispersion outside the tagged area, approximately 93 percent of initial inoculation had accumulated in the 0-45 cm depth of soil by October 1967. Surface income to the forest floor through rain leaching and litter fall has contributed only 19 percent of the ¹³⁷Cs burden in the 45-cm mineral soil layer; therefore, the contribution from the roots of the tagged trees must have been more than 80 percent. (Research sponsored by the U. S. Atomic Energy Commission under contract with the Union Carbide Corporation.)

(132)

Control of Gibbosity in *Lenma gibba* G3 by Ethylenediamine-di-o-hydroxyphenylacetic Acid (EDDHA)

ARNOLD H. PIETERSE, PRITHVI R. BHALLA AND PRITAM S. SABHARWAL, *University of Kentucky*

Lenma gibba occurs in two forms. One is conspicuously gibbous (swollen) and the other is essentially non-gibbous (flat). Whether these are distinct genetic races or merely ecological modifications of the same race is disputed. We have recently observed that when flat forms are cultured in $\frac{1}{3}$ Hutner's medium supplemented with the iron chelate EDDHA at concentrations ranging from 0.1 to 100 ppm, the plants become gibbous. Gibbous plants are characterized by the swelling of the abaxial surface of the fronds. The degree of gibbosity depends on the concentration of EDDHA.

EDDHA has also a profound influence on flowering. When EDDHA is incorporated in Hutner's medium, flowering is observed while the controls remain vegetative.

(128)

Respiration Studies with a Dark-grown Blue-Green Alga

JOHN D. PIKE AND RAYMOND W. HOLTON
The University of Tennessee

Manometric and polarographic measurements of the respiratory rate of *Chlorogloea fritschii* have been made. Heterotrophic cells grown in the dark on sucrose responded to various inhibitors and substrates in the same way as autotrophic cells grown in the same medium. Added substrate sugars and organic acids had little or no effect on whole cell endogenous respiration. The uncoupler 2, 4-dinitrophenol failed to stimulate respiration, while carbonyl cyanide *p*-trichloromethoxyphenylhydrazine (CCCP) stimulated respiration markedly. The inhibitors HCN and orthophenanthroline decreased respiration while diethyldithiocarbamate showed a slight increase over controls. Further cell-free experiments in assay of dehydrogenase enzymes are in progress and will be described.

(80)

Thermal Emissivity from a Grassland

GAYTHER L. PLUMMER, *University of Georgia*

In order to evaluate how thermal-emission patterns vary in an ecological system according to ordinary variations in rainfall, overcast skies, stand height of the crop, and throughout the circadian rhythm, a Bermuda-grass lawn was sensed remotely with an IR-thermometer continuously during the summer. The records showed that variations in the concurrent atmospheric factors diurnally influenced thermal-emission more than either variations in the wetness of the site or variations in the height of the grass; under nocturnal conditions the wetness of the site influenced thermal emission patterns more than either sky-cover or stand height. The role of thermal emission at night, especially in the spring-time, is not only important ecologically for germination, growth and reproduction, but the real significance of all nocturnal environmental conditions can best be appreciated by those plant ecologists who yet trim a rye-grass lawn with a push-mower.

(17)

The Effect of Surrounding Tissues on the Opening of the Hypocotyl Hook

ROBERT D. POWELL AND PAGE W. MORGAN
Texas A & M University

It has been known for some time that cotyledons inhibit the red light induced opening of the hypocotyl hook in beans. Recently, we reported that the cotyledons of cotton are essential for hook opening. The opposite response of these two species leads to the question of how cotyledonary tissue of other seedlings influences opening of the hypocotyl hook. A series of plants with varying seed size and with or without fleshy cotyledons from several families were tested and the relationship of the cotyledons and root tissue to hook opening determined. The results of these experiments will be discussed.

(226)

Effects of *Hymenolepis* (Cestoidea, Cyclophyllidae, Hymenolepididae) on the Larvae of *Tribolium confusum*: Hatching of the Tapeworm Oncospheres in the Beetle Host

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The presence of *Hymenolepis* cysticercoids in the hemocoel of *T. confusum* larvae has been found to cause retardation of growth and development of the host. Worm burden, incidence of infection, and length of retardation are directly correlated with the size of larvae at the time of feeding, and duration of larval development is proportional to the worm burden. Factors that may be involved with these effects are pathological damage, hormonal imbalances, and nutritional competition. In order to study the above factors, hatching of *H. microstoma* oncospheres as they enter the digestive tract of beetle larvae has been observed, along with the viability and infectivity of the oncospheres. (Supported in part by contract AT (40-1) 1749, AEC, and by NSF Grant GY 6110, Undergraduate Research Participation.)

(212)

Progress Report on Southeastern Flora

A. E. RADFORD, *University of North Carolina*
(No Abstract)

(214)

Some Helminths from Animals at Busch Gardens Zoological Park

C. V. RADHAKRISHNAN AND R. E. BRADLEY
University of Florida

Out of 53 fecal samples recently examined from various animals at Busch Gardens Zoological Park, Tampa, Florida, ova of gastrointestinal helminths were detected in 27 or 50.9%; *Trichostrongylus* sp. (Nematoda; Strongyloidea) and *Trichuris* sp. (Nematoda; Trichuroi-

deae) were the dominant species. Larvae of *Dictyocaulus* sp. (Nematoda; Strongyloidea) were isolated from over 70% of the fecal samples from the Blesbuck (*Damaliscus albifrons*) and the Springbuck (*Antilopea marsupialis*). Necropsy of 6 Blesbucks yielded adult parasites identified as follows: *Haemonchus contortus* and *Ostertagia circumcincta* (Nematoda; Strongyloidea), *Trichostrongylus axei* (Nematoda; Trichostrongyloidea), and *Dictyocaulus filaria* (Nematoda; Strongyloidea). A few females of *Trichostrongylus* sp. (Nematoda, Trichinelloidea) were recovered from a Gazelle (*Gazella subgutturosa*) and a Dik Dik (*Madoqua phillipsi*). Necropsy of 2 Manatees (*Trichechus manatus latirostris*) revealed large numbers of *Chlorobius fabaceus* (Trematoda; Digenea) in the cecum and colon and *Plicatolabia hagenbecki* (Nematoda; Ascaroidea) in the stomach.

(194)

The Ecological Energetics of a Laboratory Population of *Chironomus tentans*

LYNN RAULERSON, *University of Georgia*

Chironomid larvae are prominent components of the benthos in freshwater habitats, and are an important food source for many aquatic carnivores. Some chironomids are said to be herbivores or detritivores; it appears that *Chironomus tentans* is a bacterivore. This species can be raised in the laboratory from "egg to egg"; as such it is an ideal candidate for energetics studies under controlled conditions.

The energetics of an organism or population can be stated by the formula: $I = G + R + E$, where I is ingestion, G is growth, R is respiration, and E is egestion (feces, or non-assimilated material). Growth, as such, includes increase in biomass, egg production, and molts. All parameters are expressed as calories. Because *C. tentans* is a holometabolous insect which undergoes four molts during its larval stage, all parameters were calculated for the larval stages, the pupae, and the adults. Growth was calculated by weighing a population once a week during its life span; population parameters such as emergence, egg production, and mortality were determined at that time. Respiration was determined by the bottle method and by the Gilson differential respirometer. Feces were collected over a two-hour period and dry-weighted. Caloric determinations were made in a semi-micro bomb calorimeter; materials assayed included various-sized larvae, pupae, adults, exuviae, feces, and molts.

(114)

A Genetic Approach to the Problem of Langerhans Cells

WILLIE M. REAMS, JR., *University of Richmond and the Medical College of Virginia*

Using the techniques of developmental genetics, Mayer (Intl. Pig. Cell Conf., 1969) has demonstrated that in several spotting genotypes of mice the alleles affect the neural crest directly. The result is a neural crest deficiency which is expressed in part as pigment cell-free spots. Piebald lethal (s/s¹) mice obtained from Mayer were investigated with histochemistry and electron microscopy for the condition of the epidermal Langerhans cells. These cells have been purported to be of pigment cell lineage. DOPA and EM confirmed the complete absence of pigment cells in the white spotted areas. However, the ATPase method and EM dem-

onstrated that in the same areas, indeterminate dendritic cells (pro-Langerhans cells?) and Langerhans cells were present in normal numbers. Thus further evidence is given for the epidermal Langerhans cells being independent of the pigment cell lineage. (Supported by PHS Grant AM 11864. The work was done in part at the Virginia Institute for Scientific Research.)

(170)

Ovule and Sporogenous Tissue Development in *Cassia abbreviata* Oliver var. *granitica* (Angiospermae: Leguminales: Caesalpiniaceae) by the Application of Traditional Techniques

DAVID H. REMBERT, JR. AND J. M. HERR, JR.
University of South Carolina

Standard methods for fixing, sectioning, and staining ovularies permit a number of succinct and amply descriptive comments on ovule and sporogenous tissue development. This traditional approach reveals, for example, that in *Cassia abbreviata* var. *granitica* as many as fifty ovules are initiated and follow a rather uniform pattern of early development. A single hypodermal archesporial enlarges in the nucellar apex before the ovule primordium arches toward the stylar region. Division of the archesporial cell produces a parietal cell and a primary sporogenous cell. Increase in the apical nucellar mass is initiated by division of the parietal cell. Concomitantly, the sporogenous cell enlarges and directly produces the megasporocyte. Subsequent megasporogenesis results in the formation of a linear or a T-shaped tetrad of megaspores. Some problems inherent in studies of this type especially those imposed by the traditional techniques will be considered.

(107)

Microsporogenesis and Microgametogenesis In *Vernonia cinerea* Less. (Compositae)

JOHN D. REYNOLDS, *Virginia Commonwealth University*

The anther originates near the base of the petals. Anther wall formation is of the Dicotyledonous type. The microsporocytes are arranged in single vertical rows in each of the four anther loculi. The microsporocytes divide mitotically prior to undergoing meiosis. No synchrony in meiosis occurs within the loculi of the same anther. Two meiotic divisions result in the formation of four haploid nuclei, in a tetrahedral arrangement, each connected by spindle fibers. Wall formation is simultaneous. Each microspore is surrounded by a gelatinous sheath while still enclosed by the PMC wall. Echiniae form prior to division of microspore nucleus. Pollen are three-celled when released. Tapetal nuclear divisions and fusions occur prior to formation of a periplasmodium.

(108)

Megasporogenesis and Megagametogenesis In *Vernonia cinerea* Less. (Compositae)

JOHN D. REYNOLDS, *Virginia Commonwealth University*

A single anatropous ovule with a massive integument originates from tissue at the base of the ovarian locule. The ovule is tenuinucellate; the single archesporial cell functions directly as the M.M.C. A linear row of mega-

spores is usually formed at the end of meiosis but variations occur. The chalazal megaspore is usually functional but variations were noted. An endothelium differentiates prior to dissolution of the nucellar epidermis. Embryo sac development is of the *Polygonum* type. The number of antipodal cells and the number of nuclei per cell is not constant. Fusion of polar nuclei occur prior to entrance of the pollen tube, which enters the embryo sac between the slightly hooked synergids. Double fertilization occurs. Possible cases of apospory are noted.

(195)

The Relationship of Earthworm (Oligochaeta: Lumbricidae and Megascolecidae) Distribution and Biomass to Soil Type in Forest and Grassland Habitats at Oak Ridge National Laboratory.

JOHN W. REYNOLDS, *University of Tennessee*

Studies in forest and grassland habitats extended the records of Tennessee terrestrial earthworms from 8 to 14 species. In the forest area six soil types were chosen, three ridge top and three bottomland. Three soil types were examined in the grassland area. Five earthworm genera were recorded: *Allolobophora* and *Den-drobaena* only from the grassland, *Bimastus* and *Diplo-cardia* only from the forest, and *Octolasion*, the only genus with more than one species present, from both locations. *Octolasion cyaneum* was present only in the forest and *O. lacteum* on both grassland and forest sites.

Earthworm densities in the forest ranged from 2 to 96 per m², and in the grassland from 13 to 41 per m². Wet weight biomass in the forest ranged from 1.3 to 41.1 g/m². The range of biomass estimates for grasslands were 3.2 to 7.5 g/m². The maximum biomass for forest and grassland soil here were <70% and <15%, respectively, of values reported in European literature for comparable ecosystems. (Research supported by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.)

(76)

Distribution of Fallout Cesium-137 in the Upper 4-Inches of Soil in Relation to Vegetation Type

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Soil samples were collected to a depth of 4-inches in 1-inch increments from three vegetation types, oak, pine, and grass, in northern Mississippi. Gamma-ray spectrometric analyses of the samples were made to determine the concentration of fallout cesium-137. Cesium-137 concentration decreased with increasing depth in the soil profile with the upper 1-inch soil layer having a higher concentration than the other three layers combined. The amount and depth distribution of cesium-137 was similar under the pine and oak forests. Cesium-137 concentration in the surface inch under the grass cover was less than either the oak or pine. Cesium-137 concentration was found, however, in higher concentrations to greater depth under the grass cover than under either the oak or pine forest. Possible explanations for the differences in cesium-137 distribution under the different vegetation cover are erosion, accumulation of organic matter, and cycling within the ecosystem.

(10)

Effect of Oxygen and Carbon Dioxide Tensions on Release of Amino Acids and Sugars from Peanut Roots under Gnotobiotic Conditions

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This investigation was undertaken to learn more about the role of peanut root exudation in relation to the ecology of soil microorganisms. Peanut plants were maintained in sterile plexiglas isolator chambers to prevent utilization by microorganisms of root released compounds. Amino acids and carbohydrates released from the roots of peanut plants *Arachis hypogaea* L., var. NC-2 grown in flasks of complete nutrient solution were collected aseptically.

Three separate experiments, each lasting six weeks, were performed. Gas mixtures were bubbled into the nutrient solution for 30 sec. every 12 min. for the duration of the experiment. The three gas mixtures were composed of: 1—CO₂ (10%), O₂ (21%) and N₂ (69%); 2—O₂ (21%) and N₂ (79%); 3—CO₂ (10%) and N₂ (90%). One group of plants received nitrogen gas only. Flow of gas mixtures was controlled automatically. Gas mixtures were sterilized by filtration before entering the chambers.

The analytical procedure used to determine the kinds and amounts of amino acids and carbohydrates present in the peanut root exudates was: 1—filtration, 2—flash evaporation, 3—desalting with ion exchange resins, 4—concentration by freeze drying, 5—qualitative thin layer chromatography, and 6—quantitative densitometer determinations. The results will be discussed.

(181)

Drosera rotundifolia L. on Cascades Creek, Danbury, N.C.

HOLIS J. ROGERS
University of North Carolina at Greensboro

A substantial disjunct colony of *Drosera rotundifolia* L. was found on a south facing mica schist and quartzite wall at the foot of the Lower Cascades, Cascades Creek, Danbury, North Carolina on October 4, 1969. The species here is restricted to a thin substratum of thallose liverworts, maintained by water seepage from a horizontal crevice in the wall. This colony at 900 feet above sea level is more than 100 miles from any previously reported and is the first to be reported from the piedmont of North Carolina. Other known locations are in the mountains and on the coastal plain.

This same general area contains both *Tsuga caroliniana* Engelm. and *T. canadensis* (L.) Carr. in addition to *Leiophyllum buxifolium* (Bergius) Ell. and *L. buxifolium* var. *prostratum* (Loudon) Gray.

That this well established community of Sundew has escaped detection in spite of intensive work in this specific area by the writer and several other biologists for more than twenty-five years is a surprising discovery and warrants further investigation.

(222)

Epistylis (Ciliata: Peritricha) Epizootics of Fish in the Southeastern U.S.

WILMER A. ROGERS AND S. E. COOP

Fish Disease Project Agri. Exp. Sta., Auburn University

Cases of the stalked ciliated protozoan, *Epistylis* sp., causing a characteristic "red-sore" disease of fishes, have been reported to the Southeastern Cooperative Fish Disease Laboratory from virtually every state in the Southeastern U.S. Epizootics occur most frequently during the winter and spring months. Research has shown that this species is not an obligate parasite but only uses the host fish as an attachment site. The root-like attachment organelle, penetrating the skin of the fish, apparently secretes an enzyme that dissolves the fishes' scales and produces a pit-like inflamed sore. The ciliate also infests scaleless fishes (catfish). Bacterial infections often occur secondary to the *Epistylis* infestation. Although the disease is widespread, only a few cases are known where mortalities have occurred. Observations on the life history show a formation of telotrochs which are characteristic of the Peritricha. Preliminary laboratory tests show that a single treatment with potassium permanganate at a rate of 2 ppm or formalin at a rate of 15 ppm will control *Epistylis*.

(92)

The Relation Between Artificial Substrate Size and the Number of Fresh-Water Protozoan Species

JEANNE A. RUTHVEN AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute

Two groups of ten polyurethane substrates of different sizes ranging from 45 mm³ to 25600 mm³ were set out in Douglas Lake, Michigan. The number of freshwater protozoan species in samples taken from the substrates over a six-week period was determined, and comparisons were made between the number of species in substrates with different sizes and between the number of species for each substrate at different sampling periods. The number of species associated with each substrate increased over time until a maximum number of species was recorded within the 4th to 6th weeks of sampling. The number of species remained nearly constant or decreased slightly after reaching a maximum. Results indicate that within a minimal size range, volume affects the number of fresh-water protozoan species. Smaller substrates generally had fewer species than the larger substrates, and a linear relationship is shown between log volume and number of species.

(1)

Transpiration of *Antirrhinum majus* Under Environmental Stress¹

RUFUS B. RUTLAND AND JAMES E. PALLAS, JR.²

Difficulty in growing snapdragon in the greenhouse during the warm seasons can possibly be accounted for by reduced photosynthetic efficiency and internal water stress associated with high evaporative demand of the atmosphere.

Transpiration was measured under known or controlled environmental conditions and was found to follow closely the intensity of incident radiation (400 to 2,000 nm) in the greenhouse. In controlled environment chambers, transpiration was accelerated at high

temperature, high light intensity, or high vapor pressure deficit. Wilting occurred before stomata closed under extreme conditions. Cool soil induced plant-water stress. No wilting occurred in plants growing at air and soil temperature of 25° C, 20 mb v.p.d., and 0.88 ly/min, whereas wilting was pronounced in 10° C soil. Transpiration was reduced 50% at the cooler soil temperature. On reversal of treatment an immediate response permitted the assumption that reduced root growth was not the principal mechanism inhibiting absorption.

¹ Contribution from the Southern Branch, Soil and Water Conservation Research Division, Agricultural Research Service, USDA, and the University of Georgia Agricultural Experiment Stations. Proposed for presentation at the Southeastern Association of Biologists Meeting, Lakeland, Florida, April 2-4, 1970.

² Assistant Professor, Department of Horticulture, University of Georgia, Athens, Georgia 30601; and Plant Physiologist, USDA, Watkinsville, Georgia 30677.

(124)

Nitrogen Fixation by *Rhodospirillum rubrum* Measured Manometrically in Correlation with Malate Metabolism

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By growing *Rhodospirillum rubrum* in the light under nitrogen without any bound nitrogen in the proper media, it is possible to obtain bacteria with a very high capacity to fix nitrogen gas. The rates are high enough to be easily followed manometrically upon addition of a suitable hydrogen donor, such as malate. The measured amounts of nitrogen gas that disappear can be found again as fixed nitrogen in the cells after the experiment. In contrast to organisms that include only L-malate in their metabolism, these bacteria make use just as well of D-malate. Sometimes the nitrogen fixation rate curve for DL-malate shows a break at the half-way point when the D-component of the racemic mixture comes into play. [Supported by NASA grant No. 10-004-018 to Professor H. Gaffron]

(11)

Evidence for a Complex Zinc Absorption Isotherm in Excised Barley Roots

WALTER E. SCHMID AND RALPH E. BRANDON
Southern Illinois University

Recent literature indicates that ion absorption in plant tissues does not show a simple curvilinear relationship to external concentration of substrate ion, but rather that the relationship has several inflections. Heretofore most studies have dealt with macronutrient ions such as Rb, K, and P although Cl and B also have been examined. Very recently it has been reported that no such complex relationship is obtained when Zn, Cu, or Mn are the substrate ions. The present report will provide evidence to the contrary (for zinc) and will show that absorption isotherm for this ion is indeed quite complex.

(164)

Zoogeography of North American spiders (Arachnida: Araneida), Especially Wolf Spiders (Lycosidae)

RONALD SCHMOLLER, *The University of Tennessee*

The North American spider fauna comprises over 2500 species. The distribution of many species tends to fall into several common patterns. These patterns or "spider provinces" are similar to those of most other animal groups (e.g. mammals). Certain areas of the continent are sadly lacking in published information on the spider faunas. The relative importance of the various spider families varies in different parts of the continent.

Tentative natural provinces are delineated for some of the 300 species of North American wolf spiders (Lycosidae). I have prepared species lists, hopefully helpful to collectors, of the "common" and "rare" lycosids known to occur in various regions of the continent. Apparent concentrations of highly endemic species of wolf spiders occur in Florida, Mexico, and the mountains of the western United States. Ranges of the various genera and of selected species are given. Altitudinal distribution patterns are discussed.

(137)

The Appearance of Pyrimidine Nucleoside and Deoxynucleoside Kinase Activities in Peanut Axes

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The appearance of pyrimidine nucleoside and deoxynucleoside kinase activities in peanut axes was followed during the first 90 hr of germination. The activation or synthesis of these enzymes preceded increases in RNA, DNA, and fresh weight. The incorporation of DNA precursors into DNA occurred only after the appearance of the pyrimidine deoxynucleoside kinases. These data suggest a possible role for these enzymes in the metabolism of DNA and RNA in the early development of the peanut seedling.

(24)

The Effect of Aqueous Seed Extracts of *Abrus precatorius* L. on Seed Germination and Seedling Growth

DAVID L. SCOTT, *University of South Alabama*

AND

M. REHAN SIDDIQI, *Miami University, Ohio*

An investigation was conducted to determine whether water extracts from seeds of *Abrus precatorius* would inhibit seed germination and retard seedling growth. An attempt was also made to locate the part of the seed where the inhibitor is most concentrated. Seeds of mung bean, barley, lettuce, wheat, radish, and oats were subjected to cold water extracts from the whole seed, the cotyledon, and the seed coat. In each treatment, the extract was used in concentrated form, 1/5 dilution, and 1/10 dilution. Distilled water was used as a control. After a one week observation period, germination percentages were calculated at the various concentrations in each treatment and compared with the percentage germination of control seeds. Surviving seedlings at

each concentration were weighed and compared with the average weight of control seedlings. Germination of all seeds tested was inhibited by the concentrated extract from the whole seed. Concentrated extract from the cotyledon yielded similar results. No inhibition by extract from the seed coat was observed at any concentration. Extracts from both the whole seed and cotyledon induced retardation of seedling growth. The degree of retardation was proportional to the concentration of extract. Seedlings grown in extracts from the seed coat appeared to be unaffected. (Research supported in part by the National Science Foundation through the 1969 Advanced Seminar in Tropical Botany held at the University of Miami.)

(54)

Studies on Chemically Induced Physio-morphological Changes in a Water Mold, *Allomyces macrogynus* (Chytridiomycetes: Blastocladales: Blastocladiaceae)

SHUKDEB SEN AND LAFAYETTE FREDERICK
Atlanta University

Physio-morphological changes in *Allomyces macrogynus* were induced by using various chemicals, namely adenine, aureomycin, benzyl adenine, niacin and sodium barbital. Cultures of *A. macrogynus* have been grown on one-fourth strength Emerson's YpSs agar supplemented with each of those chemicals. A non-supplemented one-fourth strength of YpSs agar served as control medium. Microscopic observations revealed that at concentration of 3γ/ml of adenine and 3γ/ml of benzyl adenine a higher percentage of male gametangia formed on gametothalli. A concentration of 0.1 mg/ml of benzyl adenine was found to induce higher percentage of Z.S to R.S on sporothalli, whereas 9γ/ml of barbital sodium caused an increase in the number of gametangia forming on gametothalli. Concentrations of 3γ/ml of benzyl adenine and 9γ/ml of barbital sodium were found to induce a higher percentage of R.S on gametothalli. Concentrations of 9γ/ml of barbital sodium and 4γ/ml of aureomycin were found to induce "hyphal" protuberations from Z.S, whereas a concentration of 25γ/ml of barbital sodium induced "hyphal" protuberations from gametangia as well as sporangia. Concentrations of 1γ/ml and 4γ/ml of niacin were found to induce spore germination within the Z.S.

(191)

Seedling Response of Two Dune Grasses, *Ammophila breviligulata* Fern. and *Uniola paniculata* L. (Monocotyledoneae: Poales: Poaceae), to Various Photoperiods and Thermoperiods

ERNEST D. SENECA, *North Carolina State University*

Photoperiod and thermoperiod experiments were conducted in the Southeastern Plant Environmental Laboratory (North Carolina State Unit) on seedlings of two dune grasses, *Ammophila breviligulata* Fern. and *Uniola paniculata* L. (Monocotyledoneae: Poales). Seedlings of each species were grown from seed collected from two or more geographically separated populations. Results from these studies indicated that seedlings of *A. breviligulata* grow best in lower daytime temperatures (70 to 80 F) under long-day conditions. Seedlings of *U. paniculata* exhibit best growth in higher daytime

temperatures (80-90 F) and demonstrate minor response to changes in day length. Interaction between photoperiod and thermoperiod was demonstrated in seedling growth of both grasses. Based on these studies it appears that there is more photoperiod- and thermoperiod-related intraspecific variation in *A. breviligulata* than in *U. paniculata*.

(60)

Isozyme Patterns of Certain Wood-rotting Basidiomycetes

MICHAEL C. SHANNON, S. K. BALLAL AND JOHN W. HARRIS
Tennessee Technological University

Crude and acetone extracts of four species of *Poria* and two unidentified species of wood-rotting fungi grown in cultures were subjected to starch gel electrophoresis, and stained for esterase and catechol oxidase activity. The location and intensity of the esterase bands were specific for each species tested; catechol oxidase isozymes were specific for the three species in which they were present. Isozyme patterns of esterases alone or in combination with other enzymes may be of some use as criteria for the establishment of taxonomic and phylogenetic relationships among these Basidiomycetes.

(103)

Epidermal Features of Several Populations of *Glandularia canadensis* (Verbenaceae)

G. K. SHARMA
University of Tennessee at Martin, Tennessee

Several populations of *Glandularia canadensis* (Verbenaceae) are isolated in different parts of North America and grow in varied environments. Members of these populations were grown in a common environmental chamber having controlled light, temperature, and humidity conditions. Their leaf epidermis were studied. It was found that stomatal frequency, epidermal cell frequency, stomatal index values, and trichome frequency were quite variable in these populations, although some of these features were related somewhat to geography and environment. However, all the populations examined had 3-4 stomatal size classes and a subsidiary cell complex made up of usually 3 cells—thus these two features, being common to all populations, may have taxonomic importance in this species complex. The same species occupying different ecological habitats was found to retain at least two common epidermal features while variation of other epidermal features in different populations suggests their ecotypic significance.

(66)

Different Ideas Concerning the Migration of Vascular Plants and Bryophytes from the Old World to the New

AARON J. SHARP, *The University of Tennessee*

The movement of plant taxa from Asia into North America by the Bering route has been much discussed. If we accept continental displacement, it is just as logical to assume that some of the taxa reached North America via Europe when the continents were connected, or at least closer together. The present ranges of certain plants and bryophytes may be more easily explained if we assume their migration along such a route.

(173)

Carpelloid Stamens in *Rubus trivialis* Michx. (Angiospermae: Rosales: Rosaceae)

HARRY E. SHEALY, JR. AND J. M. HERR, JR.
University of South Carolina

In several plants of *Rubus trivialis*, selected by chance during a routine collection from a small population, nearly the entire androecium of each flower is composed of carpelloid stamens. The carpels contain two anatropous, unitegmie, crassinucellate ovules attached to the placenta one above the other. The ovule adjacent to the style degenerates while the basal ovule ultimately develops into a seed. Megagametophyte development basically follows the *Polygonum* type. The carpelloid stamens demonstrate a variety of structural modifications several of which markedly influence vascular distribution. These modifications support the phylogenetic concept that the carpel and stamen are homologous structures. Carpelloidy in the androecium well may represent one of the mechanisms by which unisexuality is derived. The survival of the carpelloid condition is certainly enhanced by apomictic reproduction, a characteristic feature of *Rubus*.

(90)

Effect of Gamma Rays on the Longevity, Reproduction, and Death Rate of *Rhyzopertha dominica* Fabricious (Bostrychidae; Coleoptera)

HARPAL SINGH AND JOYCE A. LIGGINS
Bennett College

The purpose of this experiment was to find if 5000R given in a fractional division of 1670R each would produce any different effects on *R. dominica* in contrast to a single exposure of 5000R.

One week old adults of mixed sexes of *R. dominica* were divided into two groups. One group was exposed to a single dose of 5000R. The other group was exposed to three equal doses of 1670R, giving a total of 5000R. Previous experiments have shown that a single exposure of 5000R was sufficient to sterilize adults. It was found that the adults irradiated at 5000R exhibited a post-irradiation survival pattern similar to that of the control. However, the rate of mortality was slightly higher in the irradiated group than in the control. At this dosage, the adults surviving the first thirty-day mortality period following the exposure continued to live as long as the control group. This suggested that some insects are more tolerant of the same dose of irradiation than others of the same species.

The single dose group produced no eggs, nor did the fractional dose group. The longevity was 15.3% higher in the single dose group than in the fractional dose group. The fractional dose group showed a death rate that was 5.6% higher than that of the single dose group. The experiment indicated that 5000R given in three fractions was as effective as the single dosage in producing sterility. The difference was shown in the longevity and the death rate.

(172)

Megagametogenesis and Early Embryogeny in
Ammannia coccinea Rothb. (Angiospermae:
Myrtales: Lythraceae)

BRUCE B. SMITH AND J. M. HERR, JR.
University of South Carolina

The trilocular ovulary in *Ammannia coccinea* contains numerous anatropous ovules borne on a columnar, axile placenta. With curvature of the young ovule, uneven growth of the integuments produces an abruptly angled micropylar passage, a feature seldom associated with anatropous ovules. Of several sporogenous cells produced in the tenuinucellate nucellus, one enlarges to form a megasporocyte. The megaspore tetrads are uniformly linear, and megagametogenesis from the chalazal megaspore follows the *Polygonum* type. A hypostase one cell layer thick envelops the chalazal portion of the 2-nucleate megagametogenesis. Prior to syngamy, the polar nuclei fuse and the antipodals disintegrate. The synergids, however, persist after syngamy until a copious nuclear endosperm develops. Maximal size is attained by the megagametophyte at the 4-nucleate stage, but the greatest increment of growth occurs during enlargement of the functional megaspore. Embryogeny follows the Crucifer pattern exhibited by several other members of Lythraceae.

(46)

Effects of Size, Injury, and Starvation on the
Shedding Frequency of *Elaphe guttata* and
Heterodon platyrhinos

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Savannah River Ecology Laboratory
University of Georgia

Elaphe guttata and *Heterodon platyrhinos* were maintained in the laboratory at 25°C with a 12 hour photoperiod. The average shedding frequency for 10 *E. guttata* from May to October was 4.1, with a range of four to five. The average shedding frequency of 16 hatching corn snakes for a five month period was 3.6 with a range of three to four. In both groups of snakes, shedding frequency was not affected by the amount of growth of different individuals. Starved snakes exhibited the same shedding frequency as fed individuals.

The average shedding frequency of 10 *Heterodon platyrhinos* from May to October was 2.4, with a range of zero to five. Starvation in this species reduced or eliminated shedding. Injury increased the shedding frequency in this species, but not in *Elaphe guttata*.

(87)

Supplementary Food and Population Dynamics
of the Old Field Mouse

MICHAEL H. SMITH, University of Georgia

Supplementary food in the form of wild bird seed has been supplied to a population of old-field mice, *Peromyscus polionotus* for three years. Compared to the control population, the experimental population maintained a higher density and reproductive rate but had the same average body weight. These results will be discussed in relation to modern theories of population regulation.

(127)

The Induction of Delayed Fluorescence in
Chlorella pyrenoidosa by a Short
Intense Light Flash

MICHAEL SMOLEN, University of Tennessee

Delayed fluorescence from *Chlorella pyrenoidosa* was observed 20 to 100 milliseconds after a 6 joule, 200 microsecond flash. A single flash was observed to cause the emission of relatively little delayed light whereas after two consecutive flashes the amount of delayed light increased threefold. This is interpreted as the formation of an activated state which occurs between a dark-adapted state and a light-adapted state. The kinetics of formation of this activated state and its significance in current schemes of photosynthesis will be discussed.

(39)

Certain Aspects of the Biological Activity
of Serotonin

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Southern Bio-Research Institute and Department of
Physics, Florida Southern College

During the last decade, serotonin (5-hydroxytryptamine), a metabolite of a hormonal nature, has been attracting much attention from physiologists. Its biological activity is multi-sided. The present report concerns the effect of simulated high-altitude air on certain deviations of fat metabolism in rats. It was observed that at an altitude of 20,000 to 30,000 feet there is a substantial decrease in the blood triglycerides and cholesterol. On the other hand, with the injection of serotonin to rats for ten consecutive days, an increase in these two fat metabolites was observed. This increase is temporary: when serotonin injection is stopped, the triglycerides and cholesterol tend to return to their normal level. The technique of simulated high altitude air experiments is described. The possible mechanism of the effect of serotonin on certain fat metabolites is discussed. (This research was supported by NASA Grant #NRG-10-012-001.)

(241)

Bioaccumulation and Toxicity of DDT and its
Metabolites in Small, Wild Mammal Populations

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Clemson University

Selected tissues of small, wild mammals collected from an area subjected to seasonal application of insecticides were found to contain sizable amounts of DDT. The data suggests that the acquisition of a body burden by natural populations may be cumulative rather than exhibiting seasonal fluctuations. Laboratory experiments using one of the species collected in the field (*Sigmodon hispidus*) revealed that bioaccumulation of DDT in liver, brain and gonadal tissues was correlated with the concentration of the food source and suggested possible routes for the metabolism of DDT.

(99)

Polyploidy and Reproductive Mechanisms in the *Erigeron grandiflorus* Complex (Compositae) of Western North America

STEPHEN A. SPONGBERG, *University of North Carolina*

The alpine members of the *Erigeron grandiflorus* complex (Compositae) of western North America have been investigated cytologically and with regard to reproductive mechanisms in an attempt to understand the origins and interrelationships of this arctic-alpine species complex. Correlations between polyploid level and reproductive mode are evident: the diploids are sexual and self-compatible, while triploid and tetraploid species produce seed through obligate agamospermy. Vegetative propagation, as a supplementary method of reproduction, is correlated with habitat severity. Species of this complex restricted to snowbank communities with extremely short growing seasons and to areas of talus and scree with highly unstable substrates develop rhizomes in addition to either sexual or apomictic seed production. Plants of other species in this complex, in less stressful habitats, do not reproduce vegetatively.

(220)

Chemical Attractants of Schistosome Miracidia

GLENN M. SPONHOLTZ, *Florida State University*

Controversy has existed concerning chemosensitivity of miracidia to snails and snail products. MacInnis (1965) gave evidence that miracidia show positive behavioral response, a chemotaxis, to selected chemicals. The present work is concerned with demonstrating a chemotaxis of *Schistosoma mansoni* miracidia to *Biomphalaria glabrata* products and the identification of these products. A simple, quick assay was devised, and evidence of a positive chemotaxis was obtained. Snail washings elicited approximately a 70% response as compared to 10% for controls. The dializable substance(s) is freeze- and heat (100°C)-resistant. Analysis of concentrated materials by gas chromatography shows no detectable short chain fatty acids. Hydroxyproline, threonine, and glutamic acid were detected by means of the automatic amino acid analyzer. Analysis for other substances such as carbohydrates and polyfunctional acids is in progress.

(73)

An Ecological Study of a Rhode Island Right-of-Way, Exeter, Rhode Island

RICHARD STALTER, *Pfeiffer College*

The vegetation on a recently cleared utility right-of-way and the relatively undisturbed forest in the Wolf Rocks region of Exeter, Rhode Island, were compared using three tracts along the right-of-way paired with tracts in the adjacent forest. Vegetation in the right-of-way was only partially destroyed; thus the return to the vegetation structure of the adjacent forest would be expected to occur rapidly in view of the profuse stump sprouting. However, a program of right-of-way management to produce a closed community of medium to low stature shrubs shows promise of success.

(72)

The Zonation of Vegetation in Southeastern Salt Marshes

RICHARD STALTER, *Pfeiffer College*

The zonation of salt marsh vegetation in 12 southeastern salt marshes was studied to determine similarity of species composition. The dominant vegetation in these arbitrarily determined vegetation zones are the High High Marsh, dominated by *Baccharis* spp., *Iva oraria*, and *Spartina patens*; the Low High Marsh, occupied by *Borrichia frutescens* in its upper portion and *Salicornia* spp., *Spartina alterniflora*, and *Limonium carolinianum*; the High Low Marsh, occupied by a pure stand of dwarf *S. alterniflora*; and the Low Low Marsh by a pure stand of tall *S. alterniflora*.

The factors that influence zonation are soil solute concentration, depth and duration of flooding, inter and intra-specific competition, and depth of water table. The pH is unimportant in restricting the vegetation to certain zones while soil texture and organic content are of doubtful importance.

(186)

Transplantation of Salt Marsh Vegetation, Georgetown, South Carolina

RICHARD STALTER, *Pfeiffer College*

A salt marsh located on the Baruch plantation at Georgetown, South Carolina includes four vegetation zones: the High High Marsh, Low High Marsh, High Low Marsh, and Low Low Marsh. Thirty plants of each of the dominant vegetation in each zone were transplanted into the other three vegetation zones, and thirty plants of each of the dominant species in each zone were dug up and replanted in the same zone to serve as controls.

Survival and growth rate of the transplants suggest that several species can tolerate conditions not found in their usual zones. *Salicornia virginica* of the Low High Marsh can grow in the High Low Marsh and Low Low Marsh, while *Limonium carolinianum* of the Low High Marsh survived when planted in the High Low Marsh.

The data suggest that there are two forms of *Spartina alterniflora*, a dwarf form occupying the High Low Marsh, and a tall form occupying the Low Low Marsh.

(204)

Evolutionary Patterns in the *Spiranthes cernua* Complex (Orchidaceae)

JOHN C. STEVENSON, *University of North Carolina*

The *Spiranthes cernua* complex comprises four South-eastern U.S. taxa including *S. cernua* var. *cernua* (L.) Richard, *S. cernua* var. *ochroleuca* (Rydberg) Ames, *S. cernua* var. *odorata* (Nuttall) Correll, and *S. ovalis* Lindley. Experimental evidence indicates that *S. cernua* var. *ochroleuca* is an outbreeding sexual diploid and *S. cernua* var. *cernua* is an apomictic tetraploid, while *S. cernua* var. *odorata* is a self-compatible sexual diploid. Taxonomic problems have arisen in this complex primarily due to the polymorphic results of mass asexual biotype formation and secondarily by wide phenotypic variation within clones. Since *S. cernua* var. *odorata* has a distinctly different ecological habitat, robust morphology, divergent breeding system and pos-

sibly different pollinators, it may be best regarded as an allied but separate species from *S. ceruua*. The status of *S. ovalis* is still in question but appears to be cleistogamic and may be of hybrid origin.

(136)

Effects of Ethionine, Ionizing Radiation, and 5-Fluorouracil on Development of Invertase and Methylation of RNA in Sugar Beet Disks

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and Horticulture Department, Purdue University

Aeration of sugar beet disks over a 72 hour period resulted in a linear increase of invertase activity. The presence of ethionine and 5-fluorouracil in the incubation. Ethionine inhibited incorporation of ^3H -uridine zyme development by 80 and 16 per cent respectively. Methyl group incorporation from methionine into RNA occurs during the first 6 hours of tissue aeration. Transfer RNA has the highest specific activity of methylation. Ethionine inhibited incorporation of ^3H -uridine and methionine- $^{14}\text{CH}_3$ into ribosomal and transfer RNA whereas 5-fluorouracil selectively inhibited ribosomal RNA synthesis and methylation with little effect upon t-RNA. In tissue exposed to 100 kR of ^{60}Co γ -rays and subsequently aerated, there was a stimulation of invertase development. There was a differential stimulation of t-RNA synthesis and methylation in irradiated tissue. The level of amino acid acceptor activity for leucine t-RNA increased during the first 6 hours of aeration. Transfer RNA extracted from ethionine treated tissue has lower charging capacity for leucine and was similar to that from unwashed tissue.

The data suggest that synthesis and methylation of t-RNA is required for development of invertase in dormant storage tissue of sugar beet.

(179)

Preliminary Results of ATP Pretreatment on Radiation-Induced Chromatid Aberrations in *Tradescantia*

MARMAN H. STOVALL, JR. AND PRISCILLA S. RUSHTON
Memphis State University

Inflorescences of *Tradescantia paludosa* were pretreated with ATP and exposed to 100 R of x-irradiation. Microspores were fixed one day later and chromatid aberrations were scored. The frequency of both chromatid breaks and chromatid exchanges was significantly reduced with this treatment, while isochromatid breaks were not affected. Results of these experiments indicated that both the concentration of ATP and length of pretreatment required to produce the maximum effect agreed closely with data reported for chromosome aberrations.

(125)

Light-Dependent Hydrogen Production by Photosystem I of *Scenedesmus*

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Institute of Molecular Biophysics
Florida State University

Photoproduction of hydrogen by adapted, illuminated *Scenedesmus* required photosystem I, since 10^{-6}M DCMU

was only slightly inhibitory. Relative efficiencies in far-red light of photosynthesis, photoreduction and photohydrogen production were determined. Hydrogen production was comparatively the most efficient. *Scenedesmus* mutants characterized by Bishop were tested. Mutant PS-50, lacking cytochrome 552, did not photoproduce H_2 . Mutant 11, blocked in photosystem II, produced H_2 at approximately the same rate as wild type; and, like wild type, this process was apparently stimulated by Cl-CCP. This uncoupler inhibited the diminished photoproduction of H_2 by mutant 8, which is blocked in photosystem I. Thus photoproduction of hydrogen by photosystem I is probably due to either cyclic photophosphorylation or to photooxidation of organic compounds by the photosynthetic electron transfer chain. [Supported by AEC contract (40-1)-2687.]

(159)

Taxonomy of Two Populations of an Aquatic Isopod, *Lirceus fontinalis* Raf. (Crustacea, Isopoda, Asellidae)

CLARENCE E. STYRON, *St. Andrews Presbyterian College*

Two populations of *Lirceus fontinalis* in DeKalb County, Georgia, are isolated in separate river drainages and are evolving independently in response to different environmental factors. Though the same species morphologically, members of these two populations differ both physiologically and ecologically. They differ significantly in their complement of amino acids, in their respiration rates and tolerance to anaerobic conditions, and in their tolerance to a combination of gamma radiation, high temperature, and drought. On this basis members of the two populations are considered to be ecotypes or races of *L. fontinalis*. Quantitative methods of classification and identification will be emphasized.

(208)

Phenological Records of Vascular Plants at Oak Ridge, Tennessee

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Oak Ridge National Laboratory, Oak Ridge, Tennessee

Date of first flowering for 225 vascular plant species has been recorded during the spring seasons from 1963 to 1969 at Oak Ridge, Tennessee. Sixty species were woody, whereas 165 were classified as herbaceous. This array was comprised of 164 genera representing 70 families. The woody taxa contained observations on 48 genera from 28 families, and the herbaceous plants consisted of 116 genera from 42 families. More species were observed to flower in April than in any other month. Twenty woody species flowered during that month in contrast to 77 herbaceous species. This total represented 52 genera among the herbaceous plants and 17 among the woody plants. These observations are intended to call attention to date of first flowering, and in many cases illustrate the variation observed within a seven year period. Since vegetative growth usually diminishes with the onset of the reproductive life cycle, knowledge concerning date of flowering would be especially valuable in analysis of ecosystems and in biomass estimations. (Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.)

(64)

Isozyme Taxonomy of *Chlorococcum* (Chlorophyceae, Chlorococcales, Chlorococcaceae)

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Louisiana State University in New Orleans

Proteins of whole cell extracts from 16 *Chlorococcum* species and 3 *Tetracystis* species were analyzed for isozymes of nonspecific α -esterases (α -EST), leucine aminopeptidase (LAP), and malate dehydrogenase (MDH) by starch-gel electrophoresis. The species were heterogeneous regarding the presence, number, electrophoretic mobility, concentration, and distribution of isozymes. The patterns ranged from simple to complex. Each species could be identified by a combination of banding patterns of the 3 assays, and with most species, only one assay was required. The nonspecific α -EST patterns were the most differentiating. MDH patterns were more conservative and uniform. Only 9 species showed LAP activity and these patterns were diverse. The isozyme data are discussed in relation to current knowledge of morphological, ultrastructural, physiological, immunological, and pigmentation studies. Taxonomic application of algal isozymes is considered.

(237)

Community Structure of the Macrobenthos in Four Tributaries in the Pre-impoundment Basin of the North Anna River, Virginia

M. H. THOMAS, Virginia Water Control Board

G. M. SIMMONS, JR., Virginia Commonwealth University

Virginia Electric Power Company plans to construct a nuclear fueled power station on the North Anna River in Louisa County, Virginia, with a 14,500 acre reservoir to serve as coolant for the reactor. A study is currently being conducted to evaluate existing, pre-impoundment benthic communities and water quality which are strongly influenced by acid mine drainage from three abandoned pyrite mines on a tributary, Contrary Creek. The North Anna River below the confluence of Contrary Creek is in the process of recovery but lacks the molluscan element of the benthic community which is present above its confluence. A study of the macrobenthic invertebrates was made in the tributaries to the North Anna River below Contrary Creek in an effort to determine which elements were being re-introduced into the recovery zone. This study showed that within the tributaries a diversified molluscan population was present. Siltation is presented as the primary factor restricting recolonization of molluscs in the recovery zone.

(165)

Observations on the Mating of the Spider, *Tetragnatha elongata* Walck.

MARY SUE TISDALE TORRES AND H. L. HANSEN
Purdue University

(read by H. M. Field, Florida Southern College)

Nine matings were observed in the laboratory. The mating behavior of *Tetragnatha elongata* was compared with published observations on other members of the Tetragnathidae.

(55)

Analysis of the Fat of *Phlyctochytrium* sp.

GILBERT S. TRELAUNY, Madison College

Gas chromatography of extracts showed the presence of palmitic acid 25%, stearic acid 19%, oleic acid 37%, and linoleic acid 19%. Approximately 50% of the fatty acids were in the free form and 50% appeared as glycerol esters. These two fractions accounted for about 31% of the dry weight of this organism.

(41)

The Life History of the Salamander *Eurycea* *bislineata wilderae* in Western North Carolina (Amphibia: Plethodontidae)

ROSEMARY TREVARTHEN, Western Carolina University

Over 1500 larvae and adults of *Eurycea bislineata wilderae* were taken from springs in Jackson County, North Carolina. Egg deposition dates from January to April and hatching occurs from March to June. The larval period lasts for 13-14 months with metamorphosis occurring predominantly in June. The salamanders remain sexually immature for a year following metamorphosis. The testes of mature males contain sperm from August to November. The breeding season, defined as the period during which the vasa deferentia are filled with sperm, is from October to April and coincides with this salamander's aquatic phase. Ovarian egg counts of 91 gravid females range from 14 to 76 (mean = 30). Field clutches vary in egg number from 12 to 56 (mean = 27). Egg numbers are positively correlated with body size. Females were observed at 31 out of 35 nests and with 7 out of 9 groups of hatchling larvae.

(149)

The Thyroid Gland and Tail Regeneration in the Lizard, *Anolis carolinensis*

JAMES E. TURNER AND SAMUEL R. TIPTON
University of Tennessee

Lizards injected with thyroxine and maintained at 32° C with a 14 hour photoperiod began blastema formation 2 to 3 days earlier than controls. The initiation of blastema formation in thyroxine treated lizards began on day 6 after tail amputation. Controls began blastema formation 8 days after amputation. Blastema formation was completed several days earlier in the thyroxine treated group. However, there was no significant difference between the rate of development of the blastema in either group. Tail elongation proceeded at the same rate in both groups for the first 3 weeks; however, the total growth achieved during this period was significantly greater in the thyroxine treated lizards. Tail growth began to taper off between the third and fourth week after amputation. This tapered growth occurred 2 to 3 days earlier in the thyroxine injected group. These results indicate that thyroxine initiates the early formation and subsequently the early completion of the tail regeneration process but does not necessarily alter the rate of growth.

Lagenidium culicidum as an Agent of Biological Control of Mosquitoes

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AND

CHU S. HUANG

Chipola Junior College, Marianna, Florida

Lagenidium culicidum, an aquatic fungus isolated into pure culture from a living mosquito larva, has proven to be a virulent parasite of *Culex restuans*. In laboratory experiments the level of infection in larvae varied with the amount of inoculum which was supplied as zoospores. Over 90% of four day old larvae subjected to three units of inoculum (ca. 0.5 million zoospores) were killed within 72 hours, whereas 10 day old larvae with the same quantity of inoculum were stricken only at a 5% level. However, with nine units of inoculum over 80% of larvae at ages up to 10 days were killed. There was noted, too, when three or six units of inoculum were used, a significant increase in larval mortality when density of the host population was increased. High levels of mortality prevailed in all tests, regardless of host density or age, when nine units of inoculum were applied. This fungus has been shown to have similar degrees of effectiveness against other species of culicine mosquitoes, and its potential as an agent of biological control of certain mosquitoes is promising.

Biosystematic Study of the Species Groups Altissimae and Giganteae of the Genus *Vernonia* (Compositae)

LOWELL URBATSCH, *The University of Georgia*

The four species within the species groups Altissimae and Giganteae of the genus *Vernonia* have not been well understood or clearly defined. Variation within and between the taxa was studied by means of local population samples, herbarium specimens, and living plants. Several characters were scored on the local population samples and the results compared graphically. Members of the two species groups were crossed with most of the other approximately 20 species of United States *Vernonia*. A number of F₂'s and BC hybrids have been produced along with the F₁'s. Chromosome pairing at meiosis and pollen stainability as an indication of fertility were examined in the hybrids. Reciprocal transplant garden experiments have been made to determine possible ecotypic differences. Range determinations were made from the herbarium specimens. This biosystematic study was undertaken in order to give a clearer understanding of the variation pattern and the evolution of these taxa.

Pollen Development in *Podocarpus macrophyllus* D. Don (Gymnospermae). I.

I. K. VASIL AND H. C. ALDRICH
University of Florida

Histochemistry and ultrastructure of pollen development in *Podocarpus*, from the initiation of male cones

to the formation of mature pollen grains, has been studied. Sporogenous cells are strongly pyroninophilic and rich in histones. No cytostictic channels are formed. Long, thin, three-layered, unit-membrane-like structures or tapes of an intensely electron dense material appear in the cytoplasm of microspore mother cells during early meiosis. Precursors of sporopollenin, the principal constituent of the pollen exine are synthesized within the tapetal and microspore mother cells. Deposits of sporopollenin-like material are seen on elements of the endoplasmic reticulum as well as Golgi cisternae. The nucleus of the haploid microspores of the tetrad seems to play an important role in the synthesis and transport of exine precursor substances and ribonucleoproteins. The mature exine can be differentiated into a sexine, and nexines I, II and III. Exine surface has also been studied with scanning electron microscope.

The Biology of the Tar Spot Gall caused by *Asteromyia carbonifera*

FRID M. VEAL, *Tucker High School, Tucker, Georgia*

AND

EDWIN G. BECK, *University of Georgia*

The larvae of the midges of the species *Asteromyia carbonifera* are involved in the formation of mycetozymotomological galls on the leaves of several species of *Solidago* plants. The females deposit the eggs and a fungus in the mesophyll tissues of the leaves. The fungus grows in the mesophyll tissue about the developing embryo and serves as food for the larvae. Ultimately the fungus forms a thick layer between the mesophyll and the epidermis. The older hyphae turn black, which imparts the dark color to the older galls. The growth of the fungus ceases when the larva pupates.

Crystallization Patterns of Vaginal Mucus in Guinea Pigs

DENNIS D. VENABLE AND WILLIAM W. MILLER, III
Northeast Louisiana State College

Analysis of crystallization patterns of vaginal mucus from the guinea pig has revealed a relatively simple yet consistently accurate technique for the detection of estrus in this species. Mucus was washed from the vagina with distilled water and transferred to a clean glass slide to dry. Microscopic examination revealed that dried mucus from guinea pigs in estrus exhibits a distinct fern-like crystallization pattern. A slight ferning pattern is at times also evident on the day prior to, or following, estrus. Vaginal smears taken at any stage of the estrus cycle, except approximately 36 hours preceding and following estrus, consistently failed to demonstrate the distinctive crystallization patterns. Investigations are being conducted to isolate and identify the substance or substances causing the ferning patterns found in the mucus of certain animals in estrus. Data obtained thus far suggests that the arborization pattern may be the result of increased levels of certain estrogenic substances present in the mucus. (Supported by a grant from the Society of the Sigma Xi.)

(110)

Repression of Leucyl-tRNA Synthetase of *Escherichia Coli*

HAROLD L. WASHINGTON AND LUTHER S. WILLIAMS
Atlanta University

The question being asked in this investigation was whether the formation of leucyl-tRNA synthetase was constitutive in nature or was subjected to some control mechanism. The growth of cultures in minimal-glucose medium supplemented with excess leucine, as compared to minimal-glucose medium, did not affect the specific activity of the leucine synthetase. Using an auxotroph for leucine, a shift of this culture from a medium containing excess leucine to restricting (growth rate) amounts of leucine resulted in a significant increase in the specific activity of the leucyl-tRNA synthetase for the first hour of incubation, which indicated a derepression of the rate of formation of this enzyme. After the first hour of incubation, there was a decline in the rate of synthesis and some inactivation of this synthetase activity. Further studies provide results that the addition of leucine to the highly derepressed cultures caused repression of synthesis and halted the inactivation of the leucine synthetase. These results confirm previous findings showing that the rate of formation of arginyl- and histidyl-tRNA synthetases was regulated, and suggest that the regulation of aminoacyl-tRNA synthetase formation follows a repression-like mechanism.

(207)

Aquifoliaceae of Mississippi

J. RAY WATSON, *Mississippi State University*

The only representative of the Aquifoliaceae (Holly Family) in Mississippi is *Ilex*, the genus of the hollies. Twelve species occur within the state. *I. decidua* Walt. and *I. opaca* Ait. occur throughout the state and the range of *I. verticillata* (L.) Gray is almost as extensive. *I. longipes* Chapm. and *I. montana* T. & G. occur in hilly areas, particularly in the northern half of the state. The other species are essentially restricted to the Lower Coastal Plain. Four, (*I. ambigua* (Michx.) Torr., *I. coriacea* (Pursh) Chapm., *I. glabra* (L.) Gray and *I. vomitoria* Ait.), are of common occurrence while the remainder (*I. amelauchier* M. A. Curtis, *I. cassine* L. and *I. myrtifolia* Walt.) are encountered only infrequently.

(70)

Structural Changes within an Oak-Hickory Forest Remnant in Southwestern Illinois

GEORGE T. WEAVER, *The University of Tennessee*
WILLIAM C. ASHBY, *Southern Illinois University*

In 1956 canopy dominants ($\geq 12.6''$ dbh) were *Quercus velutina* Lam., *Carya ovata* (Mill.) K. Koch, *Q. rubra* L., and *Q. alba* L. listed in order of decreasing Importance Value Index 200 (IVI). Canopy dominants in 1967 were *C. ovata* (Mill.) K. Koch, *Q. velutina* Lam., *Acer saccharum* Marsh., *Q. rubra* L., and *Q. alba* L. During the eleven-year period, stand basal area and density each increased ca. 18%. All *Quercus* spp. and most *Carya* spp. decreased in IVI. *A. saccharum* Marsh. and *C. ovata* (Mill.) K. Koch increased in IVI and together accounted for most of the density and basal area increase.

The advance of *C. ovata* (Mill.) K. Koch may be a response to high mortality of *Q. rubra* L. The development of a large *A. saccharum* Marsh. population began ca. 1900 and the changes between 1956 and 1967 reflect the continued development of this population. The initial advance on upland sites may be related to high precipitation during the late 1800's and on bottomlands to improved drainage resulting from stream entrenchment.

(123)

A New Modification of Knott's Method for Counting Microfilariae

DAVID J. WEINER AND RICHARD E. BRADLEY
University of Florida

In response to a need for a simple and easy method for counting microfilariae in blood samples, Knott's Method has been modified as follows: to the bottom at the apex of the centrifuge tube add methylene blue (1:10,000 in water) to 1 ml volume. Mix gently to suspend the button (which contains microfilariae) and using a screw-type pipetting device, take up 0.2 ml of the slurry into a 1.0 ml pipette graduated in hundredths. Wipe the pipette and deliver exactly .01 ml of the slurry onto a slide by touching the drop to the slide. A cover slip (24 x 24 mm) is then placed straight down on the drop of liquid so that there are no bubbles and the particles are spread in a circular pattern. This quantity of slurry will just fill the area under the cover slip. The slide is then placed under the microscope and counting done with the low-power (100 magnifications) objective. The number of microfilariae under the coverslip are counted and multiplied by a factor of 50 to give the actual number of microfilariae per ml of whole blood. Since this method gives a 2:1 concentration in numbers of microfilariae, in those cases where a very high microfilaremia is present, 1 ml of blood can be used which will reduce the number of microfilariae in each field by half, thus allowing a more accurate count. In this case, the total count is multiplied by 200. This method has been routinely in use in our laboratory for more than two years and has been found satisfactory.

(59)

The Distribution of Mating-type Factors in Three Groups of Basidiocarps of *Podoscypha ravenelii* (Berk. & Curt.) Pat. (Polyporales, Basidiomycetes) in Close Proximity

A. L. WELDEN, *Tulane University*

Station A was thirty-six meters from station B and twenty-six meters from Station C. Stations B and C were twelve meters apart. Single-spore isolations were made from one basidiocarp at B and from each of two basidiocarps at A and three at Station C. The homokaryons derived from these isolations were mated in appropriate combinations to determine that this species is tetrapolar, that all basidiocarps at the same station carry identical mating-type factors and, therefore, appear to be derived from a single dikaryon mycelium, and that there are five A and four B factors present in this population. The calculated outbreeding efficiency of the population is fifty-five percent. (This work supported by NSF grant #GB14296.)

Allyl Isothiocyanate as a Plant Growth Inhibitor

RAYMOND N. WESTRA, *Georgia Southwestern College*

Allyl isothiocyanate, a mustard oil widely distributed throughout the family Brassicaceae, is found in cabbage seedlings both as a free mustard oil and as a glucoside. The glucoside is apparently not acting as a growth substance while the free mustard oil is a powerful growth inhibitor. An anti-auxin effect was demonstrated by a hundred-fold increase in auxin requirement for maximum elongation of *in vitro* cabbage seedling hypocotyl sections in the presence of this mustard oil. Results indicated that allyl isothiocyanate reduced the metabolic rate of these sections, thereby extending the duration of elongation by 50 per cent. That the inhibitor is not destructive or lethal to the plant material was demonstrated by recovery of section elongation after removal from the presence of the allyl isothiocyanate.

(176)

Histochemical Comparison of Dormant and Elongating Shoot Apices of *Pinus taeda* L.

MONA M. WHITSON, *Mississippi State University*¹
WILLIAM W. ELAM, *Mississippi State University*

High concentrations of enzymes active in respiratory pathways were found in apical meristems, short shoot primordia, rib meristems, developing needle bases, and young vascular strands in a study of histochemical localization and oxygen uptake of buds and shoot apices of loblolly pine (*Pinus taeda* L.). Phosphorylase was absent in dormant buds and present in low concentrations in active apices. Lipids appear to function as primary food storage products as well as for structural components. Histochemical techniques showed developmental patterns of enzymatic activity in loblolly pine, and oxygen uptake measurements showed a general agreement with morphological patterns of shoot development.

¹ Presently Mississippi State College for Women.

(175)

The Effects of Cell Association on Growth and Differentiation of *Pelargonium hortorum* Cells *in vitro*

FRANK H. WILBUR, *University of Virginia*

The extent to which the number of cells in association influences growth and certain differentiative processes was examined. Known numbers of cells from a cell suspension of *Pelargonium hortorum* stem tissue were confined in conical chambers made from porous nylon. The cones were supported by a rack which was placed in a culture vessel containing a standardized cell suspension. At designated times, the cones were removed and the cells examined.

Growth of the cells placed in association is greatly reduced compared to growth in free cell suspension. Differentiation of tracheid-like elements occurred repeatedly under certain conditions. Embedding and sectioning the cones without disturbing the spatial relations of the cells with one another revealed that the tracheid-like elements were always associated with groups of small (<100 γ), densely cytoplasmic cells, and that they were most frequently distributed at the

apex of the cone and within 700 γ of the periphery. Results will be presented regarding the effect cell number has on this pattern and on growth.

(210)

The Vascular Flora of Crittenden County, Arkansas

W. H. WILCOX AND E. T. BROWNE, JR.
Memphis State University

Crittenden County, on the eastern border of Arkansas just west of Memphis, Tennessee, has 71 miles of the Mississippi River as its eastern boundary. The county, 603 sq. mi. entirely in the Coastal Plain Province, is nearly level with poorly drained bottom land soils. Many species collected in this survey differ from the species reported from the nearby loess bluffs just across the River.

(243)

Comparative Radiosensitivity: A Unifying Concept

WILLIAM K. WILLARD, *Clemson University*

A new and unifying concept is proposed which may allow investigators in Radiation Biology and allied fields to avoid certain disadvantages incorporated in the LD₅₀ and the LT₅₀ presently used in evaluating organism response to ionizing radiation. The index to radiation sensitivity proposed relates a time response to a given dose in terms of the mean longevity of the organism:

$$R.I. = \frac{LT_{50}}{ML}$$

Certain advantages and disadvantages of the proposed Radiosensitivity Index are elucidated.

(111)

Characterization of an Arginyl-tRNA Synthetase Mutant of *Escherichia Coli*

ARTHUR L. WILLIAMS AND LUTHER S. WILLIAMS
Atlanta University

In this study, a mutant of *Escherichia coli* with a defective arginyl-tRNA synthetase was studied in order to precise the nature of the change in the synthetase. The activity of this synthetase was determined in a crude extract and then purified to approximately 60-fold by use of various DEAE Column chromatographic procedures and pooled for determinations. Using this partially purified preparation, it was found that the arginyl-tRNA synthetase of this mutant possessed about one-half the activity for arginine acceptance as the wild type, parental strain, from which it was derived. Further, it was shown that the mutant synthetase possessed an unaltered Km for ATP and arginine, but exhibited many-fold increase in the Km value for transfer RNA, as compared to that of the wild type strain. We conclude that the primary consequence of the mutation in this arginyl-tRNA synthetase was a change in the affinity of the enzyme for transfer RNA, and this Km alteration was responsible for the reduced acceptance activity for arginine.

(154)

The Appearance of Sensory Retinal Folds in the Chick Embryo after X-irradiation

JIMMY E. WILLIAMS AND P. S. RUSHTON
Memphis State University

Stage 10-11 chick embryos, x-irradiated at 200R/minute, were exposed to 300-1000R and allowed to develop 48 more hours. Cross-sectioning revealed various degrees of sensory retinal folding. A possible explanation is that x-irradiation reduced hydrostatic pressure against the sensory retina by decreasing in some manner vitreous humor content.

(235)

What Organisms Should Be Used Now to Assess Water Quality Parameters?

LOUIS G. WILLIAMS, *University, Alabama*

Biomass measurements of the total phytoplankton per liter and the number of species of diatoms present in five microliters of diatom biomass per sample are presented for a number of sampling stations on the Great Lakes and several of the major rivers of the United States, comprising 54 semimonthly samples per station for 27 months. Dominant species of diatoms for both the spring and fall population pulses are given for 128 stations. Possible relationships of various physical, chemical, and biotic parameters of water quality are suggested for immediate application to water pollution assessment and pollution abatement.

(192)

Populational Differences in Seed Weight of *Acer negundo* L.

ROBERT DALE WILLIAMS, *Western Kentucky University*

The widespread distribution of *Acer negundo* suggests that this woody species would be suitable for the study of ecotypic differentiation. In preliminary work with the species, it has been shown that seeds from northern provinces (Minnesota, New York, Iowa) weigh more than seeds from southern provinces (Arkansas, Texas, South Carolina). Seeds from locations in Kentucky, Tennessee and Georgia appeared intermediate in weight. Calorimetric studies and their correlations with seed weight will be presented.

(187)

The Ecology of *Pieris floribunda* Benth. and Hook. (Angiospermae, Ericales, Ericaceae), in a Pine-Heath Community in the Great Smoky Mountains

CAROLINE T. WINGFIELD AND EDWARD E. C. CLEBSCH
Medical College of Virginia
and The University of Tennessee

The vegetational role of *Pieris floribunda* in a pine-heath community at 4100 elev. on Mt. LeConte was studied. Forty .05-acre plots were established for sampling, which included diameters and number of stems for trees and shrubs and a species list for herbaceous cover. Seed germination experiments were conducted. Measurements of maximum and minimum temperatures and period rainfall were made. The dynamics of the margin of the community were investigated.

(86)

Habitat Preference in an Isolated Deer Mouse (*Peromyscus*) Population

JOHN T. WINN AND LARRY N. BROWN
University of South Florida

This study was conducted on a 16 acre island isolated by a cypress swamp adjacent to the University of South Florida campus. The resident cotton mouse (*Peromyscus gossypinus*, class *Mammalia*, order *Rodentia*, family *Cricetidae*) population was studied for a year through live trapping, marking, and release. Then a population of Florida deer mice (*P. floridanus*) was introduced.

Before and after the introduction the cotton mice tended to be randomly distributed throughout the available habitats. The Florida deer mice concentrated in the oak scrub and were absent from the open areas and along the swamp border.

(139)

Peroxidases in the Cotton Plant (*Gossypium herbaceum* L.)

BRYON H. WISE AND MARTIN MORRISON
Memphis State University and St. Jude Children's Research Hospital

Peroxidases are widely distributed in higher plants, and have been implicated in disease resistance, aging, lignification, and terminal oxidation. This report describes investigations of the peroxidases present in the cotton plant. Subcellular localization of peroxidase activity by differential centrifugation of buffered isotonic sucrose homogenates of the leaves revealed that all of the enzyme occurs in the cytosol. The activity was measured spectrophotometrically by following the oxidation of guaiacol. The activity could be extracted equally well from the leaf with phosphate buffer, saline or distilled water. The isoenzymes in the stem, boll, young leaf and mature leaf were separated by acrilamide gel disc electrophoresis. Although the major isoenzyme occurs in all four tissues, one isoenzyme occurs only in leaves, and another only in the boll. Two isoenzymes that are present in the mature leaves are absent in the young leaves. A partial purification of the enzyme was achieved by ammonium sulfate precipitation followed by DEAE-cellulose fractionation. The physical and chemical properties of the cotton peroxidases are under investigation.

(52)

Microbiological Studies of Indonesian Fermented Foodstuffs

F. T. WOLF AND D. DWIDJOSEPUTRO
Vanderbilt University

Microbiological studies were made of certain Indonesian foodstuffs obtained from Malang, Surakarta, and Djakarta. *Saccharomyces cerevisiae* and *Candida solani* were isolated from ragi-roti (a baker's yeast preparation). From ragi-tempe and tempe were isolated *Rhizopus oryzae*, *R. arrhizus*, *R. oligosporus*, *R. stolonifer*, *Mucor Rouxii*, *M. javanicus* and *Trichosporon pululans*. The microbiological flora of ragi-tape was found to include *Candida parapsilosis*, *C. uelmii*, *C. lactosa* sp. nov., *Hansenula subpelliculosa*, *H. anomala*, *H. malanga* sp. nov., *Chlamydomucor oryzae* and *Aspergillus oryzae*. From ragi-ketjap, used to prepare soy

sauce, were isolated *Rhizopus oligosporus*, *R. arrhizus*, *Aspergillus oryzae*, and *A. flavus*, the latter species probably being an accidental contaminant. Two new species are described: *Candida lactosa* and *Hansenula malanga*, from ragi-tape from Surakarta and Malang, respectively.

(144)

Pasteur Effect in the Corn Seedling (*Zea mays* L.)

MELVIN YOW AND BYRON H. WISE
Memphis State University

The reversible inhibition of glucose consumption by oxygen—the Pasteur effect—may be regarded teleologically as an economy measure of the cell. Most investigations have utilized animals or microorganisms. This report describes efforts to elucidate the mechanism in a higher plant. Etiolated corn seedlings were incubated under nitrogen for 0, 5, 10, 20, or 30 minutes, and then immediately frozen in Dry-Ice-methanol. The glycolytic intermediates were extracted from the excised

root tips using cold trichloroacetic acid, and were measured spectrophotometrically. Phosphoenolpyruvate decreased sharply in 5 minutes, indicating that the triggering step of the Pasteur effect in this tissue may be the activation of pyruvate kinase (PK). The failure of pyruvic acid to rise suggests the possible activation of another enzyme “downstream” from PK. The steady increase in fructose diphosphate along with the decrease in the hexose monophosphates suggests that phosphofructokinase may also be a control point.

(211a)

Flora of Alder Run Bog, Tucker Co., West Virginia

JOAN R. GIBSON, *Smithsonian Institution*

The flora of the bog is presented, together with a history of the area. The effects of glaciation, as well as of contemporary perturbations on the size and number of vegetative zones, are discussed.

Reverend Patrick H. Yancey

Rev. Patrick H. Yancey, S.J., chairman of the department of biology at Spring Hill College for the past 35 years, died in October, 1969.

Father Yancey, who, in 1962, celebrated his fiftieth anniversary in the Jesuit order, came to Spring Hill as a scholastic (a not yet ordained Jesuit) in 1919.

He taught a course in elementary biology for four years and then, in 1923, he went to Spain to study theology at the famous medieval monastery of Ona, near Burgos. He also spent the summer of 1924 studying biology under Father Jaime Pujaila, S.J., director of the Laboratorio Biologico, at Barcelona. Returning to the United States in 1925, Father Yancey completed his theology at Woodstock College in Maryland and was ordained a priest in 1926. After a year of special studies in Cleveland, Ohio, Father resumed his study of biology at St. Louis University, under the great Father Alphonse M. Schwitalla, S.J., and received his Ph.D. in 1931.

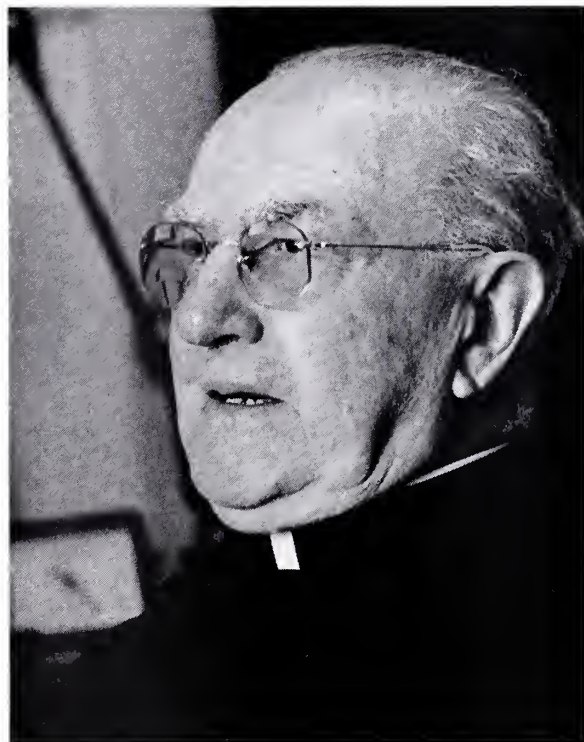
He returned to Spring Hill as professor and chairman of the department, though he was the only member for the first few years. However, as early as 1933, the department graduated its first major, the late Dr. Paul Kurzweg of Lafayette, Louisiana.

The actual number of students Father Yancey has taught would be hard to determine. However, the number of science students who have been under his tutelage are approximately as follows: biology majors, 1518; nurses, 1150; Jesuit scholastics, 510; and medical technicians, 70.

He was appointed by Former President Harry S. Truman to the National Science Foundation

Board, and has contributed widely to scientific publications in the United States and foreign countries.

Father Yancey served as president of the Alabama Academy of Science in 1938 and '39 and also has served in other official capacities with the organization.



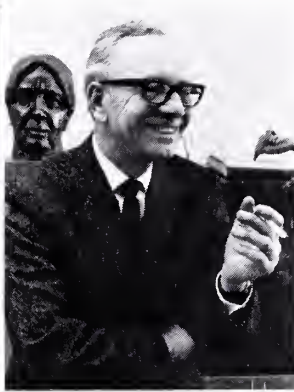
Reverend Patrick H. Yancey, S. J.



Burton J. Bogitsh



Grover C. Miller



Perry C. Holt



Leland Shanor



William E. Brillhart



James Dent



Frank B. Golley



John D. Withers

(Continued from page 14)

In 1964, he joined the faculty of Vanderbilt University, Nashville, Tennessee as an associate professor of biology—the position he currently holds.

He joined the Association of Southeastern Biologists in 1955, and has served on the Research Committee and on the Executive Committee. Other societies in which he has held membership are the American Society of Parasitologists, American Microscopical Society for which body he serves on the Editorial Review Board, Sigma Xi, Helminthological Society of Washington and American Society of Zoologists.

He has directed the Short Course in Histochemistry at Vanderbilt for the five summers it has been in existence. His research interests include investigations of host-parasite relationships, particularly the ultrastructural localization of enzymes in helminthes and their hosts.

Grover C. Miller
(President)

Since 1957 Grover Miller has been employed at North Carolina State University, where he

holds the rank of Professor in the Zoology Department. He received his A.B. in Biology from Berea College; his M.S. in Zoology from the University of Kentucky; and his Ph.D. in Zoology from Louisiana State University. Dr. Miller's research interest is in the field of parasitology and for seven years he held a research grant from the National Institutes of Health for work on parasites of mammals. At present he is working under a Biomedical Sciences Support Grant from his University. He is the author of some 21 papers, co-author of a laboratory manual in General Zoology and co-author of a textbook in Biology (in preparation) for college freshmen. For several years he lectured in summer institutes in biology for the National Science Foundation and served as Director of an Academic Year Institute.

A member of ASB since his graduate student days, he has served as Chairman of the Goethe Travel Committee, member of the Site Committee 1963-65, Co-Chairman of the Host Committee in 1966, and member of the Executive Council, 1966-69.

As a member of the North Carolina Academy of Science, he has held office as Secretary of the Zoology Section, has been Consultant and Visit-

ing Scientist since 1964, and served on the Commission on High School Biology Curriculum. He is a member of Sigma Xi and Gamma Sigma Delta.

Perry C. Holt
(Vice-President)

Professor of Zoology at Virginia Polytechnic Institute, Dr. Holt received his B.S. from Tennessee Polytechnic Institute and his Ph.D. from the University of Virginia. Before coming to V.P.I., he taught at the University of Richmond and at East Tennessee State University. Dr. Holt has been a member of the ASB since 1948, was Chairman of the Meritorious Teaching Award Committee (1966), member of the Conservation Committee (1967-69), Parliamentarian (1969), and is at present an Executive Committee member. In 1968 he organized the continuing series of symposia on the Distributional History of the Biota of the Southern Appalachians, co-sponsored by V.P.I. and the A.S.B.

Leland Shanor
(Vice-President)

Dr. Shanor received his A.B. from Maryville College and his M.A. and Ph.D. from the University of North Carolina, and his D.Sc. from Illinois Wesleyan. Having taught at Clemson University, the University of Illinois, and Florida State University, he became Professor of Botany and Chairman of the Department of Botany at the University of Florida in 1965.

Dr. Shanor's principal offices and awards are as follows: Guggenheim Fellow, 1951-52; Alumni Citation, Maryville College (1965); Trustee, Highlands Biological Station 1956-), President (1958-63); Scientific Advisory Committee, Fairchild Tropical Garden (1966-); Phytotron Advisory Committee, Southeastern Plant Environment Laboratories (1968-); Board of Governors, Center for Research in College Instruction in Science and Mathematics (1967-); Botanical Society of America (Chairman, Southeastern Section, 1966); Mycological Society of America (President, 1954); Illinois Academy of Sciences (President, 1955); Association of Southeastern Biologists (Treasurer, 1962-65); Florida Academy of Sciences; AIBS; Nature Conservancy; Phi Sigma; Sigma Xi; Gamma Sigma Delta. His research has been on the biology and taxonomy of aquatic fungi and of entomogenous fungi.

William E. Brillhart
(Executive Committee)

William E. Brillhart, Assistant Professor of Biology, Emory University, was born in Ohio, received his A.B. degree from Bowling Green State University in 1941. During World War II he served in the Army for 3½ years.

The M.A. Degree was received from Emory University in 1949. While teaching at Emory Junior College at Valdosta, Georgia, Mr. Brillhart did graduate work at Florida State University. In 1953 he came to Emory University as director of introductory biology laboratories.

Under a National Science Foundation Research Program he has worked for the past three summers at the Tropical Atlantic Biological Laboratory and the Institute of Marine Science at Miami, Florida.

As a graduate student he joined ASB in 1947, has served on the Meritorious Teaching Award Committee, and the Mary Goethe Travel Awards Committee. Membership is held in the AIBS, AAAS, and the Georgia Academy of Science.

James Dent
(Executive Committee)

Born in 1916 in Tennessee, Dr. Dent, Professor of Zoology at the University of Virginia, received his A.B. from the University of Tennessee and his Ph.D. from The Johns Hopkins University. He has taught at the University of Virginia since 1949.

During the summers of 1951 through 1958, he has been a Research Participant and Consultant in the Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. In 1959-60 he was a Guggenheim Fellow at St. Andrews, Scotland; and in 1968-69 was a U.S. Public Health Service Special Research Fellow at Harvard University.

Dr. Dent is at present Vice-President of the ASB.

Frank B. Golley
(Executive Committee)

Professor of Zoology, and Executive Director of Institute of Ecology, University of Georgia. Born September 24, 1930, at Chicago, Illinois. Married, with three children. Graduate of Purdue University, 1952 (B.S. in Animal Husbandry), and Michigan State University, 1957 (Ph.D. in Zoology). Formerly employed on a full or part-time basis at the University of North Carolina, North Carolina College, University of Wyoming and University of Puerto Rico. Author

or coauthor of *Mammals of Georgia; a Study of their Distribution and Functional Role in the Ecosystem*, 1962, University of Georgia Press, Athens; *Principles in Mammalogy*, 1963, Reinhold Publishing Corporation, New York; *South Carolina Mammals*, Charleston Museum and over 50 technical articles. Current research interests include studies of the effects of gamma radiation on wild plants and animals, and investigation of stability of structure and function in populations and communities.

John D. Withers
(Executive Committee)

Dean of Faculty and Professor of Biology at Clark College, Atlanta. Dr. Withers received his A.B. in Biology from Lincoln University, his M.S. in Zoology from West Virginia University, and his Ph.D. in Biology from West Virginia University.

During the past year, Dr. Withers has been Staff Biologist with the Commission on Undergraduate Education in the Biological Sciences in Washington, and has served for two years as an A.S.B. representative on the Council of the A.A.A.S.

Advanced Science Seminar in **TROPICAL BOTANY** at University of Miami

The University of Miami, the Fairchild Tropical Garden, and the U.S. Plant Introduction Station will offer an NSF sponsored Advanced Seminar in Tropical Botany for graduate students in plant science during the summer of 1970. The instructional staff will be:

Dr. Edward Ayensu, Smithsonian Institution
(Morphology-Anatomy)

Dr. Richard Howard, Harvard University
(Taxonomy)

Mr. Wallace E. Manis, U.S. Plant Introduction
Station (Plant Propagation)

Dr. Howard Teas, University of Miami
(Physiology)

Stipends and travel allowances are available. The Seminar will be held from June 15 - July 31, 1970. For information, write:

Dr. Howard J. Teas, Coordinator
Tropical Botany Seminar
Department of Biology
University of Miami
Coral Gables, Florida 33124

Demonstration of Hardy-Weinberg Law in Large Lectures

DIANE TeSTRAKE WAGNER
University of South Florida

The fundamentals of population genetics, so basic to understanding the mechanics of evolution, can be presented to large lecture sections of biology students by using a technique involving audience participation as a device for visual conceptualization of some of the main points of the Hardy-Weinberg Law.

Briefly the law as proposed by G. H. Hardy and W. Weinberg states: *under certain conditions, gene frequencies and genotype frequencies remain the same from one generation to the next in sexually reproducing populations.* Those conditions assume that: 1) no mate selection was occurring (random breeding), 2) migration into or out of

the population did not occur, 3) no mutations were occurring (or that mutations in the two directions were equal), 4) the population was large enough not to be affected by random changes in gene frequencies. Thus, if these assumptions are in force, evolution does not occur. However, if one or more of the assumptions are violated, then changes in gene frequencies from the original condition result and evolution occurs.

Each student entering the lecture room is presented two stapled, colored placards which are symbolic of a pair of genes. Some students receive a homozygous pair of genes, i.e., two yellow placards or two green ones, and some will be

given a heterozygous pair, i.e., one yellow and one green placard. One of the colors is designated by the lecturer as dominant.

In order to insure known percentages of the three gene pair combinations while distributing 400 to 500 of them, it is suggested that the gene pairs be assembled in packets of 25 as follows:

9 pairs of homozygous dominants or	36%
12 pairs of heterozygotes or	48%
4 pairs of homozygous recessives or	16%
Total 25	100%
Recessive gene frequency = 40%	
Dominant gene frequency = 60%	

The participating audience with placards in hand is asked to display these over their heads at which time they are told that they represent a limited gene pool. In a matter of a few minutes, calculations of the total number of each gene pair can be determined (from precounted packets or placard counts) and the percentages made known to the audience. A calculator is both useful and impressive!

Subsequent to this they are then shown how the stability of gene frequency is maintained from generation to generation through production and recombination of gametes. To derive the next generation several steps must be accomplished, the first one of which is reproduction. This is done by asking each student to "meiose" by tearing apart the stapled placards. Each card represents both one gene and one gamete. As a result of this step, each student has produced two gametes. The audience is told to choose one of their two gametes and use it to accomplish fertilization (fusion) with a gamete of a nearby student. At this time the gene-pairs are counted. Even though only one-half of the gametes are randomly paired, the

frequency of the yellow and green genes should remain the same, thus upholding the Hardy-Weinberg Law.

The consequence of violating one or more of the assumptions of this law can also be demonstrated. This is done by arbitrarily reducing the "gene-gamete" participating part of the audience to 25% of the original, thus resulting in a small population. The frequency of the genes is determined and then is compared with that of the original population.

Perhaps the most impressive deviation from a Hardy-Weinberg assumption in this kind of an audience participation demonstration is to select against the homozygous recessive gene pair by asking all those individuals with two "green genes" not to participate (non-random mating). Again lead the students through "meiosis" and "fusion" allowing only the homozygous dominants and the heterozygotes to participate. Following recombinations, inevitably there is present in the population the homozygous recessive (green-green) gene pairs.

In summary, the visual demonstration of the Hardy-Weinberg law and violations of several of its assumptions seemed to be an effective way of communicating this principle basic to understanding the mechanics of evolution.

ACKNOWLEDGMENTS

I wish to acknowledge my colleagues who have so graciously "participated" in implementing this demonstration in mass lectures! A special thanks goes to Mrs. Mary Alice Thorne for her efforts in the manuscript preparation.

Biological Science; Adjunct, Botany-Bacteriology, University of South Florida, Tampa, Florida, 33620. Contribution No. 46.

Alvin V. Beatty

As this issue went to press, we received notice of the death, on 11 February 1970, of Dr. Alvin

V. Beatty of Emory University. Dr. Beatty was 61 years old, and was a member of ASB for many years. He served as Vice-President of ASB in 1953-54, and was President in 1955-56.

Books and Periodicals

THE INSECTS OF VIRGINIA. A new series of bulletins with this title has been initiated by Michael Kosztarab of the Department of Entomology, Virginia Polytechnic Institute, Blacksburg, Virginia. The objective is to provide a systematic treatment including records on biology and ecology of the different insect orders and families in Virginia. The general policy for the series is described in the introductory article of the first bulletin. Only the results of unpublished, original research dealing with insects in Virginia can be printed in this series. The Board of Review includes James McD. Grayson, Richard L. Hoffman, and Michael Kosztarab. Manuscripts should be submitted to Dr. Grayson. One hundred reprints of bulletins are offered free to authors. Publisher is the Research Division, Virginia Polytechnic Institute.

The bulletins are printed with a yellow cover in a uniform style and size so that several may be bound together in a book form. The tiger swallowtail butterfly, collected in "Virginia" and the first insect to be described from North America, symbolizes the series; and appears on the cover of each bulletin.

The first issue (September 1969) includes two titles: I—Introduction to the series of bulletins on the insects of Virginia, with a literature review, by Michael Kosztarab; II—The biotic regions of Virginia, by Richard L. Hoffman. The second issue (October 1969) was written on the "Mosquitoes of Virginia" by William J. Gladney and E. Craig Turner, Jr. This latter article deals primarily with the distribution and bionomics of each species in Virginia, since excellent references are available on their taxonomic treatment.

Both bulletins will be sent free on request from the Publication Office, 405 Hutcheson Hall, Virginia Polytechnic Institute, Blacksburg, Virginia 24061. Exchanges are encouraged.

HORMONAL CONTROL SYSTEMS, by E. B. Stear & A. H. Kadish. Am. Elsevier Pub. Co., 52 Vanderbilt Ave., New York, N.Y. 10017, 1969, 304 p., 114 well reproduced supporting figures, \$16.00.

Two Computer Systems Specialists, five Engineers, 12 Endocrinologists and a Cell Physiologist participated in an inter-disciplinary conference. The major areas included adrenal cortical function, glucose homeostasis, thyroid function and gonadal function concerning known information about hormonal regulation and control. Following each paper, there was a presentation of a possible model, or simulation, to express an understanding of these complex biological systems.

In order to facilitate one's understanding of each paper, the reader should first acquaint himself with the figures grouped together on the pages following the reference list for that paper.

The general biologist as well as the endocrinologist will find this book of value as a limited review for references in the four areas. Two additional papers increase the worth of the book for those not directly associated with endocrinology. These are contributed by Dr. W. F. Ganong, with a discourse on "we" (page 259), he gives a short overview of brain-endocrine interrelations and Dr. R. Dulbecco with his survey of control systems and regulatory mechanisms of the basic cellular processes involving DNA and related molecules.—J. F. DIMICK, *Department of Biology, Wake Forest University, Winston-Salem, N.C.* 27109.

REVIEW OF READINGS IN CONSERVATION ECOLOGY edited by George W. Cox. Appleton-Century-Crofts, 440 Park Avenue, South, New York, New York 10016. Published May 23, 1969, pp. 595. Price \$4.95.

Cox has based this excellent book upon the assumption that the most important trend in the conservation movement today is the growing realization that conservation policy and practice must be based on sound ecological theory and must be directed toward the management of entire ecological systems. He feels that this trend has given rise to the field of conservation ecology, the aim of which is perpetuation of the economic and aesthetic values of ecological systems through maintenance of their functional integrity. The book is divided into four sections of varying length:

- Part I. Ecosystem Approach to Conservation Problems
- Part II. Problems Related to Ecosystem Energy Flow
- Part III. Problems Related to Ecosystem Nutrient Cycling Processes
- Part IV. Outlook for the Future

As one might expect, Parts II and III are the largest. Part II with fifteen articles, subdivided into four major categories:

- A. Management of Wildlife Populations
- B. Control of Undesirable Species
- C. Management of Vegetation
- D. Human Populations and Food Resources

Part III, with twenty articles, is even more subdivided into:

- A. General Introduction
- B. Problems of Environmental Pollution
 - 1. Pesticides
 - 2. Radiation and Radioisotopes
 - 3. Air Pollution
 - 4. Eutrophication of Aquatic Ecosystems
- C. Sustained Use Management
 - 1. Aquatic Ecosystems and Water Resources
 - 2. Terrestrial Ecosystems and Soils Resources.

There are thirty-nine papers in all, but merely stating the number hardly does the book justice. Among the many distinguished authors are Francis C. Evans, Eugene P. Odum, G. E. Hutchinson, Clare N. Sawyer, and Aldo Leopold. Although most of the papers have been published relatively recently, many are already regarded as classics. Inevitably, in any collection of papers, there are some missing that the reviewer or reader feels should have been included. Probably the editor had many trying moments when page limitations forced elimination of excellent articles. However, one must judge a book of this sort not in terms of the individual papers selected or omitted, but rather on the total impact of the book. From this standpoint, Cox has done a superb job! One is taken from broad sweeping generalizations to related specific instances so that abstractions, whenever possible, are supported by field data. One is exposed to the complexity of ecological problems without losing sight of the fact that the earth is a single vast ecosystem and without being overwhelmed by details.

This book should be in every university or college library and in the personal collection of anyone concerned with environmental problems. Although some of the papers may have details of interest only to the practicing ecologist, all have concepts and points of view of value to both biologists and non-biologists interested in and concerned about the ecological backlashes now occurring on "Spaceship Earth". Despite the low cost, a quality book has been produced which in terms of information per dollar spent is rarely equalled these days. — JOHN CAIRNS, JR., *Department of Biology, Virginia Polytechnic Institute.*

BIOLOGY OF POPULATIONS. B. K. Sladen and F. B. Bang, Editors. 449 pp. American Elsevier Publishing Co., New York. Nov., 1969. \$17.50.

This book chiefly deals with the problems of population biology as they are concerned with and affect public health. In a heavily populated world undergoing frequent and rapid change, population biology principles are closely tied in with the problems of population dynamics and control, medical care, and the effects of environment on man.

The four major areas of the book deal with the respective characteristics of a population which assume an importance not apparent in an individual. These areas are (1) Population Growth and Ecology (dealt with in 8 chapters in Section I); (2) Population Genetics (Section II, 7 chapters); (3) Social Behaviour and Organization (Section III, 7 chapters); and (4) Disease in Populations (Section IV, 8 chapters). Of the 30 chapters, the two editors are — separately — responsible for 12 chapters. A total of 16 authors have each contributed one or more chapters.

Section I deals with population growth in bacteria, and in viruses; with the ecology of the gastrointestinal tract; with comparative demography and experimental demography with laboratory invertebrates; with the ecology of animal communities, man's ecological environment, and with the fluctuations of vertebrate populations. Section II deals with nucleic acids and the biochemistry of some genetic processes; with animal population genetics; with microbial resistance to drugs, and the genetics of insecticide resistance; and with the genetic effects of radiations in human populations. In Section III different chapters are concerned with behavior and social organization in various animal groups including birds, mammals, domestic rodents, and nonhuman parasites, as well as in humans. Section IV treats of disease susceptibility and evolution; of experimental epidemiology; of viral induced tumors in populations; of the ecology of schistosomiasis; of arthropod populations as vectors and reservoirs of disease; of vertebrate populations as disease reservoirs; and finally of senescence as a biological problem.

The mass of well organized and selected data contain fundamental ideas from various disciplines — ecology, animal behavior, medicine, microbiology and genetics. Some of the methods used in population research are introduced, and a number of the recent advances in the field are presented. Although designed especially for disciplines connected with public health, the presentations have much carry-over of value into several different areas of biology. — WALTER S. FLORY, *Wake Forest University, Winston-Salem, N.C.*

MAN AND HIS ENVIRONMENT. Don R. Arthur. 218 pp. Illus. American Elsevier Publishing Co., Inc. Nov. 1969. \$8.50.

The book is written by an English author but deals with a theme that is relevant and of much concern in many areas of thought in our own and other countries at this time. There are four parts to the book.

Part one "The Origin of Man" follows the development, evolution, and early ancestors of Man. It culminates with "primate adaptations," a well illustrated chapter going in some detail into posture, hand development, bipedalism, the brain, family size as it deals with survival and maternal care, etc.

Part two "The Influence of the Environment on Survival" points out the basic resources necessary, as well as the nutritional ecology of Man.

In part three "The Effect of Man on the Environment" are documented the erosive, damaging and depository actions of Man. Industrial pollution, polluted effluents, pesticides, and similar items much in our current press reports are discussed and considered.

The fourth section is titled "Compromise for Survival," and deals particularly with birth rates, infant mortality, human spatial dispersion, longevity, and population parameters. Many factual data on human populations,

and population growth, are presented. The necessity for human responsibility for population control is pointed out.

Man has advanced rapidly in technological expertise. He now must consider most carefully what he has done and is doing to his environment in terms of its repercussions on human society. The study of human ecology becomes an increasingly important part of the education of all.

The main premise of this book is not new, but it is presented scientifically, concisely, and with data from many fields and many parts of the world. It tersely and competently emphasizes the critical problem in connection with human environment which must be faced and solved if the race is to survive.—WALTER S. FLORY, *Wake Forest University, Winston-Salem, N.C.*

HUMAN BIOLOGY: CONTEMPORARY READINGS by Cecil E. Johnson. Van Nostrand Reinhold Company, 450 West 33rd Street, New York, New York, 10001 — 240 pp. 1970. \$2.51.

Recently I was the lone biologist on an interdisciplinary panel discussing what the United States and the world might be like in the 1970's. There were predictions from the engineers of marvelous technological improvements which would revolutionize our ways of traveling, living and working; the economists predicted further economic growth; regional planners predicted new and exciting cities; and so it went. We were all caught up in the initial enthusiasm—who does not want a better world? Unfortunately, I was unable to relate this beautiful exciting world to the one we now live in, with the total population increasing by 50 million people each and every year, with starvation and malnutrition rampant in the world as a whole and an important factor for substantial numbers of people in the United States, with pollution becoming an increasing threat, and with natural resources disappearing at an alarming rate. Even if we were able to make the predictions a reality in our country, could we do so with a clear conscience when the rest of the world is starving and with the pollution problems not under control? If we could do this without disturbing our conscience, would starving nations let us, particularly if they happen to have a hydrogen bomb or two? Not very likely, in my opinion! I found to my astonishment that my conviction about the urgency and primacy of the population-environmental pollution problem was not shared by the others. In fact, there seemed to be a general conviction that the world population was now stabilizing, despite a lack of evidence in support of this conviction.

In addition, they seemed to feel that a reduction in birth rate was equivalent to stabilization of the population when, in fact, the birth and death rates must be in equilibrium before the population is stabilized. All of this suggests to me that biologists have not been very effective in communicating the nature of the population-pollution crisis even to their colleagues on the same campus. I certainly have failed to do this successfully, and intend to try to make amends. Very probably, a comparable situation exists on most other campuses. There are a number of excellent background books that one might use as source material, one of most recent being "Human Biology" by Cecil E. Johnson. This contains two sections—one on human population and genetics and a second on human ecology and conservation. These brief section titles cannot possibly convey the breadth of the various chapters. The seven chapters in section one have been written by Julian Huxley, Paul Ehrlich, Hans Zinsser, Alan Guttmacher, Garrett Hardin, John Rock, George and Muriel Beadle, and Theodosius Dobzhansky. The seven chapters in section two have been written by Paul Sears, Raymond Christensen, La-Mont C. Cole, F. G. Walton Smith and Henry Chapin, Rachel Carson, Leslie A. Chambers, and Justice William O. Douglas. The views expressed in the book are certainly diverse. The message, though coming from a variety of disciplines, religious backgrounds, and age ranges, is quite clear. Something had better be done very soon! The cost of this book is nominal, the reasoning sound, and reading—despite grim prophecies—is absorbing. I have been reading nearly everything I can find on the population and pollution crises, and still found that this book provided many new insights. I have no hesitation in recommending it to ASB members. I feel, however, that reading it alone is not enough. Biologists must get the message from this book and others of its kind across to other disciplines, both intellectually and emotionally.—JOHN CAIRNS, JR., *Biology Department, Virginia Polytechnic Institute.*

"WATER QUALITY CRITERIA," A Report of the National Technical Advisory Committee to the Secretary of the Interior. Published April 1, 1968, by The Federal Water Pollution Control Administration, U.S. Government Printing Office No. 0-178-250, for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. 234 pp. \$3.00.

News of Biology in the Southeast

STATE CORRESPONDENTS

Alabama — Jack S. Brown, Florence State University; James Wilkes, Troy State University
Florida — Position Vacant
Georgia — Fred K. Parrish, Georgia State College
Kentucky — Gary E. Dillard, Western Kentucky University
Louisiana — Harry J. Bennett, Louisiana State University

Mississippi — Position Vacant
North Carolina — C. J. Umphlett, University of North Carolina
South Carolina — J. M. Herr, Univ. of South Carolina; G. Thomas Riffin, Jr., Newberry College
Tennessee — Donald Caplenor, Tennessee Technical University

Virginia — Jean Pugh, Christopher Newport College
West Virginia — Earl L. Core, West Virginia University
Joseph F. Fitzpatrick, Jr. — Editor
Dept. of Biology
Randolph Macon Woman's College
Lynchburg, Virginia 24504

About People

Michael G. Chen has joined the staff of the Radiation Immunology Group, Oak Ridge National Laboratories, Oak Ridge, Tennessee. Dr. Chen received his M.D. in Medicine and Surgery from the University of Michigan Medical School and did postgraduate work in biophysics at the University of California, Berkeley.

Walter B. Panko has joined the Biochemical Regulation Group, ORNL, as a USPHS Postdoctoral Fellow. He was awarded the Ph.D. by the University of Missouri, Columbia.

William A. Elmer, a USPHS Postdoctoral Fellow with the Biochemistry of Cell Differentiation Group, ORNL, has accepted an appointment as Assistant Professor of Biology, Emory University, Atlanta, Georgia.

James L. Wittliff, who has been associated with the Biochemical Regulation Group, ORNL, as a USPHS Postdoctoral Fellow has left to accept a position as Assistant Professor of Biochemistry, Division of Oncology, University of Rochester, School of Medicine and Dentistry, Rochester, New York.

Ralph A. Zingaro, a USPHS Special Postdoctoral Fellow with the Enzymology Group, ORNL, has left to return to his position with the Department of Chemistry, Texas A & M University, College Station.

Earl R. Rich, Associate Dean, College of Arts and Sciences, University of Miami, Coral Gables, Florida, has been named Coordinator of Research for the College. Dr. Rich joined the faculty in 1957 and is an ecologically-oriented zoologist.

Thomas E. Pliske has joined the faculty of the University of Miami, Florida, after a postdoctoral tenure at Cornell University which followed receipt of his doctoral degree from the same institution. Dr. Pliske is interested in chemical communication and defense mechanisms in insects.

William N. Richardson, a plant pathologist interested in algae, has joined the Department of Biology, University of Miami, Coral Gables, Florida.

Dr. Richardson received his terminal degree from the University of California at Irvine.

Three new members have been added to the faculty of the Department of Botany at the University of North Carolina at Chapel Hill. **R. Malcolm Brown, Jr.**, formerly of the University of Texas, has assumed his duties as associate professor after an initial year's leave of absence at the Botanical Institute of the University of Freiburg. **Tom Scott** of Oberlin College has been appointed as an associate professor. **William Dickison**, formerly of Virginia Polytechnic Institute, has accepted an assistant professorship. He is replacing J. Edison Adams who has retired after 34 years of service to the Department.

Morton I. Dolin has left the Microbiology Group, ORNL, to accept a position with the Department of Biochemistry, The Agricultural University, Wageningen, The Netherlands.

Within the past year, five new staff members have been added to the Department of Biology at Atlanta University, Georgia. They are: **Frissell R. Hunter** (Ph.D., University of Iowa), a comparative physiologist with research interests in metabolic systems in flagellates, who came from Fayetteville State College, Fayetteville, North Carolina, where he was Professor of Biology; **Judith R. Lumb** (Ph.D., Stanford University), a microbiologist with research interests in immunology and virology; **Enola L. Stevenson** (Ph.D., University of New Hampshire) a plant physiologist with research interests in light quality and carbohydrate metabolism in plants; **Constance Williams** (M.S., Atlanta University) who assumes charge of the electron microscope laboratory was formerly a research assistant in electron microscopy at Purdue University and a research assistant in medical microbiology at Brookhaven National Laboratory; **Luther Williams** (Ph.D., Purdue University), a molecular biologist with research interests in the regulation of biosynthesis of amino acids, came following a post-doctoral appointment at the State University of New York at Stony Brook.

Frissell R. Hunter, Professor of Biology, Atlanta University, Georgia, is the recipient of a \$5875.00 grant from the Research Corporation to support a project entitled "A comparative study of diaphorase and isocitric dehydrogenase activities of euglenoid flagellates."

Lafayette Frederick, Professor and Chairman of the Department of Biology, Atlanta University, Georgia, has received a \$6680.00 grant from the Research Corporation to support a study entitled "Comparative studies on wall formation and endoplasmic reticulum development in ascospores of species of *Neurospora*."

Jean Delcour, who received the Doctor of Science degree in *Drosophila* Genetics from the Université de Louvain, Belgium, has joined the Biochemistry of Cell Differentiation Group, ORNL, as a Belgian American Educational Foundation Postdoctoral Fellow.

Stuart W. Hawkinson has joined the Biophysics Group, ORNL, as a Biology Division Postdoctoral Investigator. He received the Ph.D. from the University of Chicago.

Among the six marine biologists who participated in the November cruise of Duke University's vessel *Eastward* to determine oceanic metabolic rates were **Lawrence Pomeroy**, Professor of Zoology, University of Georgia, Athens; **William Wiebe**, Assistant Professor of Microbiology, University of Georgia and **John Hobbie**, North Carolina State University, Raleigh. The senior biologists were assisted by eight pre- and postdoctoral students from Duke University, University of North Carolina, Virginia Institute of Marine Sciences and the University of Georgia.

Julia F. Morton, research scientist director of the Morton Collectanea at the University of Miami, Coral Gables, Florida, spent the summer in the Caribbean area where she conducted research on folk medicine in Curaçao and Bonaire and worked with cashew development in Columbia.

Four new faculty members have been added to the biology staff of Georgia Southern College, Statesboro. **James H. Oliver, Jr.** joined the staff as Callaway Professor of Biology. Working with Dr. Oliver are **Paul J. Homsher**, Assistant Professor of Biology and postdoctoral research associate, and **Arumugam Sannasi**, postdoctoral research associate. All are investigating the cytogenetics and reproduction of mites and ticks. **Alva P. Burkhalter** is Assistant Professor of Biology with research interests in plant physiology.

James S. McDaniel, Department of Biology, East Carolina University, Greenville, North Carolina, has been awarded a grant of \$8,000.00 by the North Carolina Board of Science and Technology to support research investigating the ecology of larval trematodes and the role of man in disrupting normal regulatory mechanisms in the environment.

Vincent J. Bellis, Department of Biology, East Carolina University, Greenville, North Carolina, has received a grant of \$8,000 from the North Carolina Water Resources Institute supporting research in progress on the relation of estuarine algae to water quality.

Charles E. Bland was appointed Assistant Professor, Department of Biology, East Carolina University, Greenville, North Carolina, in September, 1969. He received the Ph.D. degree from the University of North Carolina at Chapel Hill. His research deals with ultrastructure in the Actinoplanaceae. Dr. Bland is now establishing an electron microscope laboratory with funds from an NSF College Science Improvement Grant of \$163,000 supporting undergraduate research in biology, physics, and chemistry.

Charles W. O'Rear came to East Carolina University, Greenville, North Carolina, as an Assistant Professor of Biology in September, 1969, from Virginia Polytechnic Institute where he completed pre-doctoral research in trace element metabolism in fish.

Garland E. Pendergraph was given a dual appointment as Assistant Professor in the Department of Biology and the School of Allied Health Professions at East Carolina University, Greenville, North Carolina, in September, 1969. His research interest is in the field of parasitology. He is coordinating the organization of a program in Medical Technology.

Mason Smith joined the Department of Biology of East Carolina University as an Assistant Professor on December 1, 1969. He received the B.S., M.S., and Ph.D. degrees from North Carolina State University. His doctoral research was carried out at the National Cancer Institute at Bethesda, Maryland, where he was a Special Fellow. His research interest is in comparative immunology.

Five new Assistant Professors have joined the staff of the Department of Biology, Virginia Commonwealth University, Richmond. They are: **Kenneth K. Asplund** (Ph.D., University of California at Los Angeles, herpetology), **Charles R. Blem** (Ph.D., University of Illinois, ornithology), **Gerald C. Llewellyn** (Ph.D., Purdue University, bionucleonics), **John F. Pagels** (Ph.D., Tulane University, mammalogy), and **Ronald D. Parker** (Ph.D. candidate, Brigham Young University, plant ecology).

Christopher Newport College of the College of William and Mary, Newport News, Virginia, has added four new members to the staff of the Department of Biology. They are: **Harold N. Cones, Jr.**, Instructor (B.S., Maryville College; M.A., Virginia Institute of Marine Science); **Robert J. Edwards**, Assistant Professor (B.S., Hobart College; Ph.D., University of Rochester); **Aletha S. Markusen**, Associate Professor (R.N., Trinity Hospital School of Nursing; B.S., University of North Dakota; M.S., Ph.D., Montana State University); and **Ronald S. Mollick**, Instructor (B.S., M.S., San Diego State College).

Gertrude W. Hinseh, Associate Professor of Molecular evolution and of Biology, University of Miami, Coral Gables, Florida, has been awarded a Research Career Development Award by NIH. Dr. Hinseh's research principally is concerned with reproductive cycles in crustaceans and ultrastructure of their reproductive organs. Recently, she has assisted in the examination of lunar samples by studying soil samples with the electron microscope.

Paul Yokley, Jr., Professor of Biology, Department of Science, Florence State University, Florence, Alabama, has been awarded a three year grant of \$63,810.00 by the Tennessee Game and Fish Commission and the United States Bureau of Commercial Fisheries to conduct a research program entitled "Freshwater Mussel Ecology, Kentucky Lake, Tennessee."

John T. McGinnis, formerly of the Botany Department, University of Georgia, has accepted a position as Senior Radioecologist with Battelle Memorial Institute in Columbus, Ohio. He is working in the Bioenvironmental Studies Group of the Chemical Physics Division.

James W. Hardin and **Harold E. Sehlichting**, N.C. State University, will teach Systematic Botany and Algae, respectively, at the Univ. of Oklahoma Biological Station this coming summer.

James W. Hardin, Prof. of Botany, N.C. State, and **Jay M. Arena**, Prof. of Pediatrics, Duke Univ., have published a book entitled "Human Poisoning from Native and Cultivated Plants." Duke Univ. Press, \$6.00.

About Institutions

The Department of Biology at East Carolina University, Greenville, North Carolina, is completing a move into two wings of the new \$3,500,000 science complex. The Department will occupy over 90,000 sq. ft. of classroom, laboratory, and research space. Facilities include two radiobiology laboratories, small animal facilities, greenhouse complex, climate control chamber room, transfer room, aquarium room, herbarium, shops, photographic darkrooms, electron microscope facilities, three operating rooms and eight cold rooms.

Ten graduate fellows are participants in the Department of Biology at East Carolina University, Greenville, North Carolina, in a special program for prospective teachers for small colleges. The program is funded by a \$74,500 grant from the Department of Health, Education and Welfare (EPDA) and is supervised by Joseph G. Boyette, Professor of Biology.

The University of North Carolina has received a grant of \$26,250 from the National Science Foundation to support a Short Course in Ecology for College Teachers. This will be the second year for this program. The Course runs from June 7 to July 3 and those interested

can write to the director, Dr. J. Frank McCormick, Department of Botany, University of North Carolina, Chapel Hill, N.C.

The Department of Biology of East Carolina University, Greenville, North Carolina, in cooperation with the Department of Geology, is developing a program in Marine Science on Roanoke Island near Manteo, North Carolina. David W. Kirtley, a geologist from Florida State University, was appointed full-time director of the Marine Science Center in December, 1969. The two-year old program has been operating in temporary quarters on Roanoke Island. The fall quarter program included courses in Sedimentation, Oceanography, and directed studies, and Biology of the Invertebrates taught by Stanley Riggs and Michael O'Connor of the Department of Geology and Francis Belcik of the Department of Biology.

The University of Chattanooga has merged into The University of Tennessee System as of July 1, 1969, and is now The University of Tennessee at Chattanooga. The increase in enrollment due to its new public status has caused an enlargement in the Biology Department. Dr. Richard Garth has been appointed the new head of the Department. Added also to the staff are the following: Dr. Charles Nelson as Assistant Professor, who recently received his Ph.D. from the University of Massachusetts, Dr. Patricia Perfetti as Assistant Professor, who received her Ph.D. this summer from The University of Tennessee at Knoxville, and Mr. Eric Morgan as Instructor, who has received his M.S. from Middle Tennessee State University.

A general reorganization of the Biology program within the College of Agriculture and Biological Sciences at Clemson University became effective July 1, 1969. A Division of Biological Sciences has been created which is under the direction of Dr. R. K. Guthrie. The new Division includes the following sections: Botany — Dr. W. M. Epps, acting chairman; Microbiology — Dr. M. J. B. Paynter, chairman; Zoology — Dr. A. S. Tombes, chairman. Two other Departments were involved and are now: Entomology and Economic Zoology — Dr. S. B. Hays, Head; and Plant Pathology and Physiology — Dr. W. M. Epps, Head. The M.S. and Ph.D. degrees are offered in Entomology, Plant Pathology, Plant Physiology, and Zoology. The M.S. is also offered in Botany and Microbiology. The program is designed with sufficient flexibility to permit students to pursue any special interests; for example, a student can major in Microbiology and minor in Zoology. Facilities are available for work in most areas of research including Botany, Ecology, Entomology, Microbiology, Pathology, Physiology, Taxonomy, and Zoology. Anyone desiring further information is invited to write to me or directly to the individuals listed above: N. Dwight Camper, Department of Plant Pathology and Physiology, Clemson University, Clemson, South Carolina 29631.

TREASURER'S REPORT

ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

January 1, 1969 – December 31, 1969

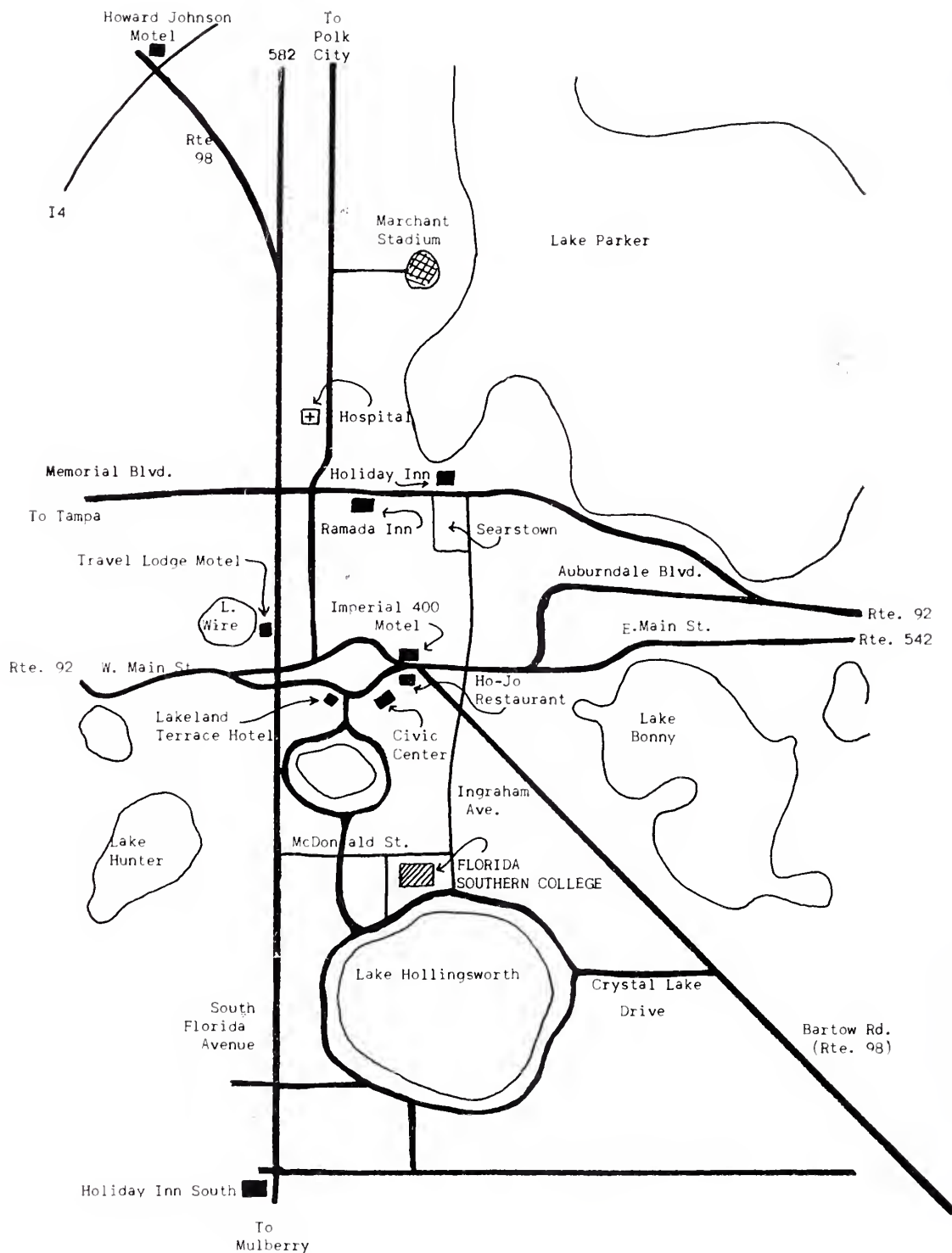
I SAVINGS ACCOUNTS

A. Regular Savings Accounts			
1. Savings Certificates	\$3,075.00		
Interest added	164.64		
		\$3,239.64	
2. Pass book account # 1472	\$ 673.27		
Interest added	30.82		
		704.09	
Total Regular Savings Account		\$3,943.73	
B. Contingency Savings Account	\$1,694.89		
Deposit	500.00		
Interest added	96.57		
Total Contingency Savings		\$2,291.46	
Total Savings			\$6,235.19

II CHECKING ACCOUNT

Balance on hand — 1/1/69		\$1,421.82	
A. Receipts			
1. Dues and Subscriptions	\$4,151.50		
2. Reprints	282.50		
3. Memphis State Meeting			
a. Dues	\$ 423.00		
b. Registration	599.00		
c. Exhibitor's Fees	1,250.00		
d. Extra Programs	109.00		
Total from meeting	\$2,381.00		
Total Receipts			\$6,815.00
B. Expenditures			
President			
Robert Short	\$ 142.85		
John Carpenter	63.83	\$ 206.68	
Secretary			
Travel	\$ 256.44		
Secretarial Assistance	80.20	\$ 336.64	
Treasurer			
Travel	\$ 58.50		
Postage	57.42		
Supplies and Mimeograph	55.13		
Secretarial Assistance	50.00	\$ 221.05	
Editor			
Travel	\$ 200.80		
Postage	50.00		
Supplies	100.00		
Secretarial Assistance	350.00	\$ 700.80	
Addressograph		511.50	
Bank (Insufficient funds, etc.)		14.63	
Goethe Awards		300.00	
Auditing Committee (travel)		28.80	
A.I.B.S. Representative (travel)		100.00	
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Respectfully submitted,
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MAP OF LAKELAND, FLORIDA

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The ASB

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Against
All Odds,
the Birds
Have Won



BY PHILIP WYLIE

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The Association of Southeastern Biologists*

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CONTENTS

Association Affairs	86
Against All Odds, the Birds Have Won. — by Philip Wylie	87
Elton Cocke Receives 1970 Meritorious Teaching Award	91
Reflections Regarding Nonpetrified Fossils. — by Frederick A. Wolf	92
News of Biology in the Southeast	95

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Against All Odds, the Birds Have Won

MIAMI—It seemed the only logical, sensible course of action. Thirty-nine square miles were purchased in central South Florida. \$13-million was spent, a landing strip for training flights was constructed. Florida desperately, obviously, needed a new jetport; the site beside Everglades National Park was eminently reasonable—within swift reach of the booming cities on both coasts, once expressways were constructed.

Yet, it is not to be. The startling fact, rumored here for weeks, was confirmed by President Nixon in mid-January: No Federal funds would be granted for a jetport in the Everglades. The port, with its satellite industries and residential developments, would have to be built elsewhere.

And all to save an apparent wasteland—a super-swamp, an endless sea of shallow-water sawgrass—from the pollution of jet sound and jet contrails, from the attendant on-ground sewage and industrial waste. All to save a 1.4 million-acre mega-bog, an infinite nothing where those tourists who are forced to stop for a tire change get out of their cars in wary dread. For the Everglades is known to abound in horrors, in alligators, poisonous snakes, clouds of mosquitoes and huge, biting flies.

Natural assets and wildlife preserves have been rescued before, just before the bulldozers moved in, but what was new here was the magnitude of the work already done, the money spent, the solid expectations suddenly rejected. What was novel was that the Nixon fiat had been made against tremendous commercial investment and popular demand and need—in the face of the jetport, its hotels and supermarkets and other cultural artifacts that would attract the whole world of air travelers and become 50 or 500 times as great a source of profits and taxes as the million or so tourists who now visit the Everglades each year.

What was portentous was the precedent: Had an example been set? Would the conservationists, the champions of ecology, outnumbered by perhaps 100 to 1, slandered for years as “fanatics who care more for birds than for people”—would these enemies of progress gain the upper hand?

The victory, of course, is not total. The existing landing strip will be used for training flights until a new site is found. The ecological effect of such flights is unforeseeable. Yet, for those who have fought the jetport, the President's announcement is a start, and more than a start—the men and women who were fascinated by the incredible birdlife in the Glades, the others interested in conserving game to shoot at; those who hoped simply to preserve swatches of wilderness for the eyes of posterity and those who understood the unique

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ecology of South Florida's Glades, yet found it difficult to communicate their knowledge to anybody else.

One logical argument the jetport opponents had been able to summon up was easily expressed. The aquifer from which the urban sprawl of coastal cities draws water might have been polluted by the development. These many-trillion-gallon stores of ground water lie only 100 feet below the porous rock of South Florida. Already, that natural storage cistern had been diminished by saltwater incursions to the east and west, caused by activities such as canal digging and drilling.

On the other side, it was pointed out that, even if the ground waters became contaminated, there was an alternate supply to the north. Yet, the threat to a vital water source was not easily talked away.

But all such arguments, and the alarms of bird lovers and hunters alike, might have gone for naught without the fast-growing American opposition to environmental pollution in general. It has made ecology big today. It has been said that every Congressman has become an ecologist overnight, though few could have defined the word a year ago. Now, it has political clout, even though Congressman and layman alike find the conception beyond their perception.

The relationship of life forms to their environment? It can be rattled off the tongue, but it still eludes the mind.

The Everglades are, ecologically, unique on the planet and extremely complex. A map of Florida will show why. The southern third of the peninsula will be marked "Everglades." This vast wetland is, in fact, three kinds of swamp. The northmost begins at Lake Okeechobee, a shallow body of tepid fresh water more than 700 square miles in area. The lake is (or was) the "head" of the Everglades supply of slow-flowing water, aptly called a "river of grass" by author Marjorie Stone-man Douglas.

This first segment of the Glades is the Big Cypress Swamp, though all the big trees save a sample owned by the Audubon Society have been cut and most of the cypress was always stunted and small, though often very old. Next comes the sawgrass region, the swamp that gave its name to the whole, an interminable prairie of brownish "grass" standing in shoal water, as a rule, and broken only by jungle domes called hammocks. The sawgrass is not grass but an abrasive sedge, and a man trying to bull through it would soon be stripped of clothing and then of skin.

The third swamp is a mangrove forest, the largest on earth, where labyrinthine waterways twist and branch and open into secret lakes. Mangrove is literally impassable for any distance, as its tentacle-like roots and stiff, entwined branches stand in slow-moving water that becomes brackish, then salty and, finally, the sea. All three swamps compose the Everglades—and it occupies the whole peninsula from edge to edge, a swamp of more

than 5,000 square miles soaked by a river that is the world's slowest, shallowest and, since man has tinkered with it, perhaps the least dependable.

A Slightly Tilted Cookie Tray

Nothing anywhere on earth is even physically similar. Southern Florida is like a very slightly tilted cookie tray with low, coastal edges where dunes and outcrops of oolite, a soft, limey rock full of fossil shells, are elevated enough for building. The cities and satellite towns string down both coasts to the place where the statewide "river" begins to merge with sea water, now the ocean-front of the park. The hammocks that interrupt the sawgrass are caused by such oolite emergences. Some are miles long, others the size of a carousel, and they support trees of many sorts, including West Indian species and most of what is left of the once-abundant mahoganies.

It is possible, of course, to build in the Glades. Many developments already encroach on them. The vast wasteland could be turned into a megalopolis with modern machinery. Excavating fill for building sites would merely leave large stretches of water canals and lakes, an effect that could rival Venice and be huge enough for 10 million inhabitants, or more. And if the Everglades were to vanish beneath an aquatic super-city, humanity could exist without missing a thing, save for a few lowly creatures.

Why guard such a priceless region from so rich a potential when, especially, the coastal strips are already solid walls of cement and the pressure of local population is desperate? With 20-odd million tourists shoveling, too!

Why halt progress, especially when progress has already played havoc with the wet wilderness and may yet destroy it, the national park included? The Army Corps of Engineers has constructed enormous "water conservation" areas to the north, diked mega-ponds that store the rainy season's deluge for urban and agricultural use. These reservoirs were made to prevent flooding, also, and they have, so far, failed to supply the park with sufficient water in dry periods to sustain its flora and fauna.

The impounded water has drowned deer in the thousands. And fresh water needed to sustain the Glades and to maintain ground-water capacity for the million or so people now in South Florida runs off, mostly, to the sea, far north of the useful points.

A Recent Close Call

Those "conservation areas" nearly killed the park in a recent drought. Loss of a national park would have been a "first" both for the engineers and for the citizens of the United States. Lucky rains supervened.

The mucklands south of Okeechobee sustain sugar cane and winter vegetable enterprises. They are another hazard. The first farmers to see the black, friable soil thought it as fertile as the dark earth of the Midwestern prairies. It wasn't. Pure humus, leached of minerals, it requires heavy fertilization, and, as it is kept dry by ditching and canals, it oxidizes — literally burns up and blows away — so the drainage systems must be deepened constantly until bedrock is reached, in a decade or two. As the digging deepens, salt water intrudes from the surrounding seas. Salt water also intrudes wherever canals have been excavated. So South Florida, like Southern California, may eventually have to get its water from upstate.

Water conservation by immense impoundments to the north has also resulted in periods of diminished brackishness in the park and the mangrove expanses. Many fish and various crustacea depend on freshwater dilution for breeding. Drought halts the fresh mix, and breeding suffers. But commercial fisheries can fail, and have failed without great public loss, and some sports fish breed elsewhere.

So there is nothing indispensable about the Everglades. The long struggle to make a good sample of the wonderland a national park was opposed by multitudes on general principles. They could not think of any commercial value for the Glades, but it was land and so should be open to private purchase. There was tannic acid in the maze of creeks and lakes, but not in a commercially recoverable form.

It was not very effective to point out that thousands of ecological niches existed in the vastness, places where plants of a single species grew, and only there, or that many life forms were present but as yet unknown to science and that the wild scene was beyond imagining — the egrets and ibises, ducks of every sort, water turkeys and real turkeys, panthers, foxes of a special breed, herons and gallinules, deer, bear, otters and endless sorts of flowers, orchids, air plants, poisonous trees and snakes.

It was almost useless to assert that this cornucopia of living wonders, if preserved, might someday supply the natural source of new and priceless drugs, for one example of the sane and possible. Such a not-too-far-out suggestion would be derided by drug manufacturers, who would assert that every natural drug from quinine to penicillin had been synthesized, a rebuttal that overlooks the fact that these miracle remedies were first found in nature.

The Reaction Inevitably Is: So What?

You could lead a supposedly informed citizen into the Audubon Society's Corkscrew Swamp and show him native hibiscus in bloom and stands of cypress bigger around than a dining room table, and you could spend

as much time as he would allow pointing out the rare, the gorgeous, the irreplaceable and the possibilities for all men in these, but his reaction would be: So what?

Trees are lumber, and a quagmire is a stinking breeder of pests. Prairies are to plough, rivers are for sewage and waste disposal, lakes are for dumping and transport and boating fun, scenery that lies over ore or petroleum deposits is to be removed or drowned in guck, and all swamps, of course, are for draining. This is land improvement and, unfortunately, even those who oppose it usually do so for superficial reasons — to watch birds, or hunt them.

The Everglades do not make a vital contribution to man's essential environment. The tremendous swamp is only a minor sample of wild environs that must be preserved if man is to continue his existence. The anti-pollution motif perhaps tilted the scale against that jetport. And even as an anti-pollution ruling, it is poorly stated.

What man must see, what this Everglades effort visualizes, is the essential human right to an environment free of pollution. Unless man gains that right, his pursuit of life, liberty and happiness will soon be impossible.

Most Americans are now urban dwellers and the great majority of those are ecological ignoramuses. They are wary when they step off paved surfaces, and they have no idea of the names of trees and wildflowers, let alone the animals, in the nearest wood. That state of mind bodes ill for the human future, for it is blank and even hostile toward the world on which man depends — the algae in the sea he calls slime, but which provides his breathable air; the flashing minnows, which mean a creek is viable.

And so man's chances are enhanced by that trifle, a clean breeze. Men want to banish the pollutants they can smell, hear, feel or detect by smarting nostrils. But who realizes that, if all the sense-perceived contaminants were gone, the job would be about 1 percent complete?

The Lesson of the Everglades

Man's great illusion continues. Nature cannot be conquered or controlled by man, as men believe, because man is not in charge of it and never will be. Who is in charge of wind and rain, of green plants and photosynthesis, of birds, insects, the seven seas? Nobody. Nature is in charge, exclusively and forever. The Everglades offer a textbook illustration of what mankind has not yet begun to face that is true:

Nobody owns anything and all anyone has is the use of his presumed possessions.

That is the ecological law. It is true for Communists as for capitalists, for disadvantaged peoples as for the affluent and industrial societies. And it is absolute.

We do not own the Everglades or any part of that strange land, even if we have a deed to it. We are allowed its use. All we do own is what our individual

skins contain. To save them we must save whatever chains of life are essential to our own.

The value of the Federal decision against a jetport rests in the symbol of the act. If the symbol is understood, its worth will be immeasurable. For man is soon going to be compelled to forego countless multi-billion dollar opportunities and change his plans for even more, not to gain a specific if obscure end of swamp salvage but for a greater though a scarcely comprehensible reason.

If all the ecologists could pool all they know and add all the data from every science, they would be unable to say what life forms and life systems are essential for man's survival. We know too little about the intricate, living understructure supporting our species to risk losing

any wild living form, weed or pest or predator, lest one break in the planetary, life-sustaining system be fatal.

There never was a guarantee by nature that man should survive for any particular time. But there are many points in the natural order of beings where a lost or broken system might result in an inexorable act of nature fatal to man.

There are X numbers of similar niches and wild lands that may have an indispensable function for man. The problem is, we don't know them; it is the major, formidable, overwhelming problem in the whole business. We don't know. We would probably continue to live and thrive, to the extent we are thriving, if we paved over the Everglades. But the emphasis is on "probably."

Because of timing difficulties, the following two abstracts were omitted from the April, 1970, ASB Bulletin.

Some Nutritional and Metabolic Studies on
Pilimelia terevasa (Actinoplanaceae)

RICHARD C. LEONARD
University of Alabama in Huntsville

Varying concentrations of several inorganic nitrogen sources failed to support growth, growth being obtained only in a complex and perhaps balanced protein medium. The best one was peptone at concentrations of 2-5% but concentrations above 6% inhibited growth. Variable, but insignificant increases in mycelial yield were obtained when a variety of carbohydrates or amides were added singly to peptone media, but amides or carbohydrates without peptone failed to support growth.

Metabolic studies, using the Warburg respirometer, indicated the non-utilization of carbohydrates and the consistent oxidation from the sixth through the eleventh day of glutamic and aspartic acids and proline. Other amino acids were oxidized at different stages of growth, but the ring amino acids, L-tyrosine and L-phenylalanine were poorly oxidized. Stoichiometric determinations of oxygen uptake and ammonia accumulation in the substrate indicated that the amino acids in peptone were probably oxidized by means of an amino acid oxidase (deaminase). Increases in oxygen uptake for certain amino acids were greater than the theoretical 2:1 ratio indicating that keto-acids resulting from amino acid oxidation were being oxidized as a source of energy.

Diurnal Variation in the Behavior and
Physiology of Bluegills
(*Lepomis macrochirus* Rafinesque)

RICHARD E. SPARKS, WILLIAM T. WALLER,
JOHN CAIRNS, JR. AND ALAN G. HEATH
Virginia Polytechnic Institute

Bluegill sunfish were acclimated for at least 2 months to a photoperiod of 12 hours of light followed by 12 hours of darkness, with simulated "dawn" and "dusk." The lighting system used special fluorescent bulbs which approximated the spectrum of daylight and a motor-driven dimmer which gradually changed the light intensity in the morning and evening. Test fish were exposed to the same photoperiod to which they had been acclimated. The movement of 3-4 inch bluegills in 5.5 gallon aquaria was monitored for 8 days using a photocell device. A polygraph was used to record heart and breathing signals from 5-7 inch bluegills maintained in plastic tubes for 4 days. In general, the breathing rate and movement of the fish was greater during the day than at night. Breathing rates and movement reached peaks during the simulated "dawn" and "dusk." Preliminary evidence suggests that there also may be a peak in the breathing rate at midday.

(This research was supported by Federal Water Pollution Control Administration grants 18050-EDQ and 18050-EDP. The large fish were supplied by the McKinney Lake National Fish Hatchery, Hoffman, North Carolina.)

Elton Cocke Receives 1970 Meritorious Teaching Award

Dr. Elton C(romwell) Cocke has made a vivid impression and a strong impact on thousands of students during his forty-five years of teaching. He taught in the public schools of Virginia for three years before entering college. Before completing his graduate work he had served two years as an assistant professor of biology at Radford College and after receiving his Ph.D. from the University of Virginia, he remained on the biology staff of that institution for an additional seven years. It has been at Wake Forest College, which is now Wake Forest University, where the greatest impact of his ability as an outstanding teacher has been felt. Dr. Cocke is completing his thirty-third year on the staff of Wake Forest University, where he has served as professor of biology since 1952. From 1960 through 1967, he was departmental chairman, where he effectively proved his ability as an able, impartial and very efficient head.

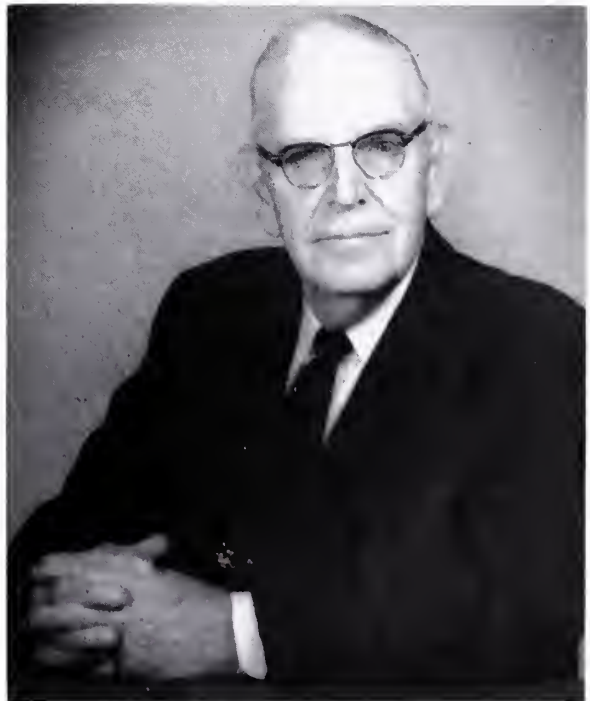
In the summer of 1968 Dr. Cocke remarked to one of his colleagues that he had checked through his old record books and found that during his years at Wake Forest he had taught 9,314 students. This does not include the additional hundreds he taught at Radford College from 1928 to 1930, at the University of Virginia from 1931 to 1938, and at Wake Forest since the summer of 1968. If these latter students were included it seems likely that those taught by Dr. Cocke would reach at least the twelve thousand level. Dr. Cocke enjoys teaching, and really enjoys students. He has the exceptional quality of making his students work unusually hard and like it. Whenever talking with one of his former students one is always impressed by the esteem and appreciation which all of these hold for him and for the help and benefit that they have secured from him.

In addition to a full time teaching load, he always found time to work on some of his research interests, the results being evident in a number of publications dealing with fossil pollen, or with some of his various algal interests. In 1968 he

completed and published a book on "The Myxophyceae of North Carolina."

Dr. Cocke is a direct descendant of Lieutenant Colonel Richard Cocke, and his ancestors came to the Jamestown area from England prior to 1628. He received his undergraduate degree and also both of his graduate degrees from the University of Virginia, and it has been mentioned that he taught at the University of Virginia for a number of years. He still has strong ties in the state of Virginia. He thus has had long and enduring ties not only in the state of Virginia but at the University of Virginia, as well as at Wake Forest University.

In 1969, Dr. Cocke published "A Short History of the Department of Biology of Wake Forest College, 1834-1967," which has proved of great value to present members of the department, as well as to the historians of the college.



Elton C. Cocke

Reflections Regarding Nonpetrified Fossils

FREDERICK A. WOLF, *Duke University*

During recent years the writer has been concerned with nonpetrified fossils that may be present in alluvial deposits (Wolf, 1968*, 1969a, 1969b). The age of such fossil-bearing deposits ranges from late Pleistocene to Eocene, a time interval that covers the period extending from about 20 thousand years ago to 50 to 60 million years ago. The occurrence of nonpetrified remains of animals and plants in sediments of such ages has stimulated my efforts to identify them, to consider the genetic and environmental factors that may be responsible for their preservation, and also to speculate on the relationship of such fossils to contemporary organisms. Unfortunately only limited knowledge of these matters has been provided by direct experimentation. In consequence there is lack of accord among paleontologists and geologists in interpretations and opinions. It is the present purpose, therefore, to reflect on these matters in the hope that, thereby, experimentation to acquire a better understanding of both nonpetrified and petrified fossils, will be increased.

It has long been known and is widely appreciated, once organisms have become infiltrated with calcium, silicon, or carbon, or else have become embedded in amber, that they are then in condition to be preserved permanently. But it is only within the current century that nonpetrified organisms have been found to be preserved in sediments for periods of thousands or millions of years. In fact, the belief that nonpetrified fossils exist has encountered considerable skepticism. Such belief, to some extent, is based on the fact that organic substances decompose readily when in contact with the soil. The ultimate length of the period that nonpetrified fossils have been preserved has not been ascertained, although petrified fossils date from the beginning of life on Earth, as evidenced by the occurrence of blue-green algae and fungi in Precambrian rocks. However, whether these earliest organisms to inhabit the Earth are generically identical with present day plants remains very doubtful.

Among investigators who have considered the antiquity of petrified organisms are Engel and associates (1968), Tyler and Barghoorn (1954) and Butler (1938-39). Engel *et al.* demonstrated the occurrence of alga-like

forms in rocks of the Onverwacht Series in South Africa. The age of these fossils, as shown by the potassium-argon method, is dated at 3,700 million years. Tyler and Barghoorn found fungus-like specimens having an age of approximately 2,000 million years near Lake Superior, in the Gunflint Formation of the Canadian shield. Butler identified a mycorrhizal fungus belonging to the well known genus *Endogone* that he found associated with *Rhynia*, a Devonian genus, that is a fossil member of the oldest group of land plants. *Endogone* is currently known to be associated with the roots of a wide variety of trees, shrubs, and herbaceous plants throughout the world. It was collected recently, Fig. A, from a 24,000 year-old deposit in Eastern North Caro-

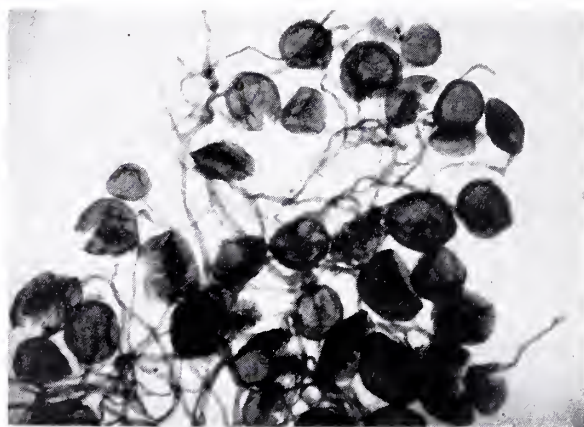


Fig. A. Colony of *Endogone* isolated by flotation from black sediment from eastern North Carolina.

lina (Wolf, 1969b). A species of *Puccinia* and a green filament of the alga *Microspora*, Fig. B, have been isolated from a clay deposit of Eocene age, in Kentucky. A nonpetrified, heterosporous, aquatic plant, given the name *Conodontophyta chattanooga* was recorded by Nease (1969) to occur in Chattanooga shale in Western Tennessee. This shale is an Upper Devonian Formation, hence has an age of a few hundred million years, and this plant may prove to be the oldest one among nonpetrified species. That nonpetrified plants of such antiquity could exist may be regarded as incredible.

* References to a series of 7 accounts that deal with fungal spores in sediments from East African lakes are listed in the 1968 report.

But permanence is relative. If a buried organism should remain without having become decayed for a few months or years, and subsequently the conditions governing resistance to decomposition should remain unchanged, that organism could be preserved indefinitely, i.e. for hundreds, thousands, or even millions of years.

The occurrence of fossils, mentioned in the foregoing accounts warrants the conclusion that certain species have not undergone appreciable morphological changes throughout their entire existence. It may well be that certain of them, as typified by *Endogone*, should be regarded as *living* fossils. Even though *Endogone* has remained unchanged morphologically from the beginning of its existence, it must have changed physiologically because association with a wide range of hosts requires the possession of a wide variety of enzymes. Either *Endogone* possessed a complement of different enzymes originally or else the enzymes were acquired, i.e., were adaptive enzymes. Apparently the evolution of an organism may not be limited to changes in structure only, but may involve (a) physiological evolution

ally, to other kinds of organisms, and also have been able to tolerate the vicissitudes of many geological and climatic changes.

Too little is yet known specifically about the various environmental factors that govern the preservation of buried fungal spores. Cores of sediment may be stratified and the kinds and numbers of spores found in different strata or at different levels or depths may vary greatly. These facts suggest that a cause of disintegration of spores may be related to the chemical nature of the strata. To test the likelihood of such relationship, known kinds of spores were stored under simulated anaerobic conditions, in each of three different kinds of soil, a kaolinite-illite clay, a black soil containing an abundance of organic matter, and one composed of fine-grained sand. After storage for a few months in these soils, differences were found among the kinds of spores that had decayed, a result indicating that decomposition of buried spores is governed, in part, by chemical differences among sediments. The nature of these differences, however, remains essentially unknown.

It may well be, also, that resistance to decomposition may be due to differences in chemical composition of the spore walls. Investigations, summarized by Aronson (1965), establish that fungal spore walls are not composed only of chitin or of cellulose, but of a complex of chemical substances. The walls are layered, as shown by electron microscopy, and each layer is chemically different, as shown by reactions to dyes.

Accord has not been reached among paleontologists regarding the taxonomy of fossils. Some deem it advisable, because of similarity in appearance of fossil kinds and contemporary genera, to assign the same generic names to fossils as are given to present-day genera. Others find this practice wholly unacceptable because contemporary organisms are maintained to be the products of evolutionary changes, and therefore they are unlike fossil kinds and hence should be given distinct form genera names. Preferably the names should terminate with *-ites*. To meet this situation it was proposed, nearly 200 years ago, that all fossil genera be named by adding the suffix *-ites* to the generic name of present-day similar taxon. Taxonomic confusion, in increasing proportions, has resulted as a consequence of these two points of view.

Several kinds of spores found in Pleistocene and Eocene sediments, that have the same appearance as contemporary genera, are shown in Fig. C. In my opinion they should be given the same names as are given to contemporary kinds. Moreover, in rare instances the structural features of fossil *species* and of contemporary *species* have been found to be indistinguishable, and the writer has assigned to them the names of the similar contemporary species.

My observations show that the vast majority of buried fungal spores are pigmented. Hyaline ones are rarely encountered. The presence of pigment or its lack are

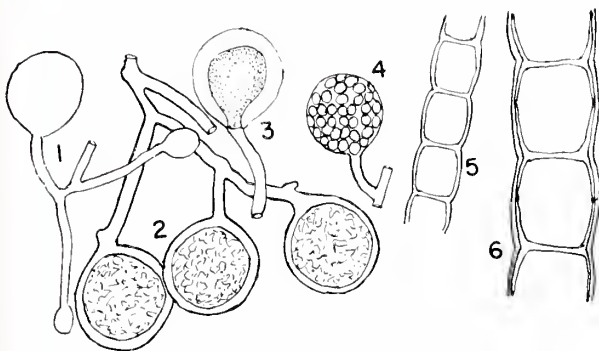


Fig. B. Structural parts of *Endogone*, and also of filaments of *Microspora*, the latter from sediment of Eocene age. 1, Young vesicles and hyphae of *Endogone*; 2, Chlamydospores of *Endogone*; 3, Proliferating sporangium of *Endogone*; 4, Thin-walled *Endogone* sporangium filled with conidia; 5, *Microspora* filament; 6, Chain of united H-shaped cells of *Microspora*.

only, (b) both structural and physiological evolution, or else (c) there may be lack of change of any kind. In all likelihood organisms that fail to evolve eventually become extinct. In effect, my examinations of non-petrified fungi compels me to conclude that the resemblance between them and present day forms is more than a remarkable, noteworthy coincidence. From their beginning fungi have demonstrated an ability to adjust completely, both morphologically and physiologic-

primary familial and tribal taxonomic characters in the widely accepted system of classification employed in Saccardo's *Sylloge Fungorum*. Could the presence of brown and black pigments constitute a factor in the resistance to disintegration of buried spores? As is well known such pigments are melanins, phenolic complexes. Pridham (1963) and Karlson (1965) have contributed substantially to basic knowledge of phenolics. Other studies, including those of Farkas and Kiraly (1962), Potgieter and Alexander (1966), Bloomfield and Alexander (1967), Akinrefon (1968), have directed attention to the role of phenols and polyphenols in resistance to plant diseases caused by fungi and to the ability of phenolics to inhibit the lysis of spores. Apparently further studies of the role of melanin in enzyme activity and in fungal metabolism should be made. Eventually the achievement of a better understanding of non-petrified fossils will result from increased cooperation among paleontologists, geologists, and biochemists.

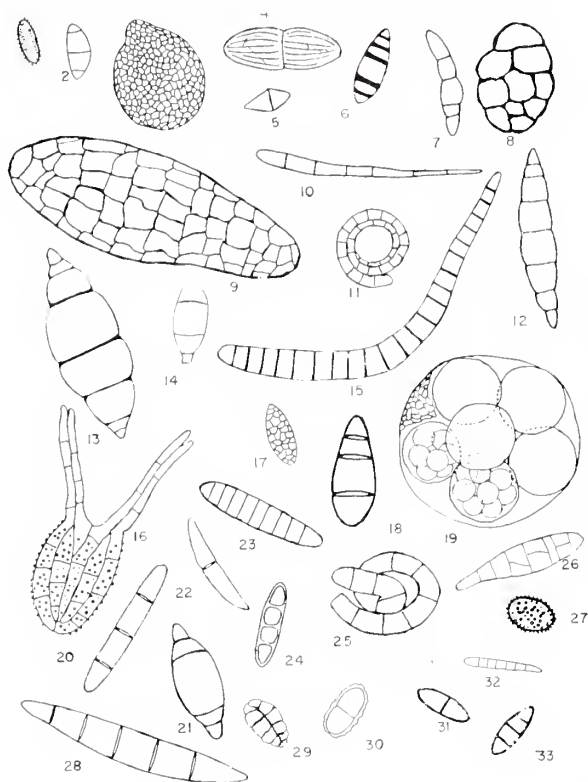


Fig. C. Various kinds of nonpetrified fossil fungal spores found in Pleistocene and Eocene deposits. 1, *Heterosporium*; 2, *Curvularia*; 3, *Coniosporium*; 4, *Cookeina*; 5, *Beltrania*; 6, *Bactrodesmium*; 7, *Blotettia*; 8, *Stemphylium*; 9, *Clathrospora*; 10, *Cercospora*; 11, *Helicoma*; 12, *Hysterium*; 13, *Leptosphaeria*; 14, *Bactridium*; 15, *Clathrosporum*; 16, *Tetraploa*; 17, *Calostilbella*; 18, *Trichocladium*; 19, *Arachniotus*; 20, *Pseudocampotum*; 21, *Dactylella*; 22, *Hypocrea*; 23, *Camposporium*; 24, *Helminthosporium*; 25, *Hob-*

sonia; 26, *Alternaria*; 27, *Ascobolus*; 28, *Clasterosporium*; 29, *Pleospora*; 30, *Sordaria*; 31, *Diplodia*; 32, *Elsinoe*; 33, *Dactylaria*.

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News of Biology in the Southeast

STATE CORRESPONDENTS

Alabama — Jack S. Brown, Florence State University; James Wilkes, Troy State University

Florida — Harold J. Humm, University of South Florida

Georgia — Fred K. Parrish, Georgia State College

Kentucky — Gary E. Dillard, Western Kentucky University

Louisiana — Harry J. Bennett, Louisiana State University

Mississippi — Position Vacant

North Carolina — C. J. Umphlett, University of North Carolina

South Carolina — J. M. Herr, Univ. of South Carolina; G. Thomas Riggan, Jr., Newberry College

Tennessee — Donald Caplenor, Tennessee Technical University

Virginia — Jean Pugh, Christopher Newport College

West Virginia — Earl L. Core, West Virginia University

Jean Pugh — Editor

Dept. of Biology

Christopher Newport College
Newport News, Virginia 23601

About People

Charles B. Metz, Professor of Molecular Evolution and Zoology, Institute of Molecular Evolution, University of Miami, Coral Gables, Florida, will direct the 1970 summer research training program in reproductive physiology at the Marine Biological Laboratory, Woods Hole, Massachusetts. This will be the ninth consecutive year that Dr. Metz has directed this program.

Gertrude W. Hinsch, Associate Professor of Molecular Evolution and Biology, Institute of Molecular Evolution, University of Miami, Coral Gables, Florida, will supervise work on the electron microscope in the summer program at the Marine Biological Laboratory, Woods Hole, Massachusetts, for the fourth year.

Paul L. Fore, **Eldon J. Levi**, **Paul J. Pristas**, **Marlin E. Tagatz**, and **E. Peter H. Wilkens**, all Fishery Biologists, Center for Estuarine and Menhaden Research, USDI, FWS, BCF, Beaufort, North Carolina, have been reassigned to the Gulf Breeze, Florida, Field Station of BCF.

Sidney W. Fox, Director of the Institute of Molecular Evolution, University of Miami, Coral Gables, Florida, will present an invited paper entitled, "Experiments related to the simultaneous origin of protein and nucleic acid," at the third International Conference on the Origin of Life at Pont-a-Mousson, France. At the same meeting, **Kaoru Harada**, senior Research Scientist with the Institute of Molecular Evolution will deliver the invited paper, "Origin and development of optical activity of bio-organic compounds on the primordial earth." In addition, both scientists will deliver several lectures before learned groups in Europe.

David H. Evans, Assistant Professor in the Department of Biology and the Division of Functional Biology, Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, Coral Gables, Florida, has been awarded a two-year grant by NSF to study the question of why some species of fish found in south Florida are euryphaline and others are not.

Thomas R. Bauman has accepted a position as Assistant Professor in the Department of Biology, University of Alabama, Tuscaloosa. Dr. Bauman is an endocrinologist who recently received his Ph.D. from the University of Missouri.

C. Earle Smith has recently been appointed Professor of Biology and Anthropology at the University of Alabama, Tuscaloosa. His field of interest is ethnobotany and he was formerly employed by the USDA Agricultural Research Service, Crops Research Division, Beltsville, Maryland.

James A. Doubles joined the Department of Biology, Troy State University, Troy, Alabama, as Associate Professor. Dr. Doubles was Ada Rittenhouse Snavely Professor at Birmingham-Southern prior to moving to Troy State. Other new appointments at Troy State include **William Norton** (M.S., Mississippi State University), Instructor in Biology, and **Danice Costes** (M.S., Auburn University), Assistant Professor in Biology.

George L. Benson has been appointed Instructor in Botany and Plant Pathology, Auburn University, Auburn, Alabama. He received the B.S. and M.S. degrees from the University of South Carolina, Columbia.

George W. Folkerts was appointed Assistant Professor of Zoology, Auburn University, Auburn, Alabama, following receipt of his Ph.D. from that institution.

James D. Harper was appointed Assistant Professor of Insect Pathology, Auburn University, Auburn, Alabama. Dr. Harper received his terminal degree from Oregon State University.

Kent L. Jones is a new Assistant Professor of Physiology, Auburn University, Auburn, Alabama. Dr. Jones received the Ph.D. from Oklahoma State University.

John Freeman and **Betty Klepper**, Auburn University, Auburn, Alabama, presented separate papers at the XI International Botanical Congress in Seattle, Washington.

John Freeman, Department of Botany and Plant Pathology, Auburn University, Auburn, Alabama, presented a paper to a NSF-sponsored meeting of the U.S.-Japan Scientific Program on Problems in the Distribution of Plants Common to Eastern Asia and Eastern North America held at Oregon State University.

J. W. Angelovie and **G. W. Huntsman**, Center for Estuarine and Menhaden Research, USDI, FWS, BCF, Beaufort, North Carolina, have been elected president and secretary, respectively, of the Carolina Oceanography Club.

Robert L. Wilbur, Department of Botany, Duke University, has been awarded a two-year grant from the National Science Foundation in support of taxonomic studies in the Gentianaceae. Dr. Wilbur will be on sabbatical, 1970-71.

In September, 1969, **Boyd R. Strain**, plant ecologist, joined the faculty of Duke University, as Associate Professor of Botany. Dr. Strain was formerly on the faculty at the University of California, Riverside. He serves as Coordinator and a project leader for the Eastern Deciduous Forest Biome project for the IBP.

Donald E. Stone, Department of Botany, Duke University, has been elected to the Executive Board of the Organization for Tropical Studies, as Treasurer of the organization.

During the spring semester, 1969-70, **Elmer A. Palmatier**, was in residence in the Department of Botany, Duke University, as Visiting Scholar in Botany. Dr. Palmatier is Professor of Botany, University of Rhode Island, and a plant ecologist with research interests in pond and bog ecology. He has been active in biological science education developments.

Resident postdoctoral research associates in the Department of Botany, Duke University, include **Hórdur Kristinnsson**, Natural History Museum, Akureyri, Iceland, in lichenology; **Manuel F. Sanchez-Diaz**, Instituto de Edafología y Biología Vegetal, Madrid, Spain, in plant physiology, and **Dan M. Heth**, Forestry Division, Volcani Institute of Agricultural Research, Israel, also in plant physiology.

In recognition of the late **Henry J. Oosting's** devotion to the training of students in plant ecology, and his keen interest in any programs benefiting their professional development, Duke University has established an endowment fund to support an annual **H. J. Oosting Memorial Lecture**. Public lectures will be presented by outstanding scientists in the field of ecology. Correspondence concerning the Memorial Lecture can be directed to **T. W. Johnson, Jr.**, or **W. D. Billings**, Department of Botany, Duke University.

Within the past year, seven new staff members have been added to the Ecological Sciences Division of the Oak Ridge National Laboratory. They are: **Charles C. Coutant** (Ph.D., Lehigh University), an aquatic ecologist with research interests in the effect of thermal additions on aquatic fauna, who comes from Battelle Pacific Northwest Laboratory, and is the new program leader for thermal pollution studies in the Division; **Jerry W. Elwood** (Ph.D., University of Minnesota), an aquatic ecologist with interest in stream productivity; **Robert A. Goldstein** (Ph.D., Columbia University), a nuclear engineering physicist with research interest in environmental pollution and systems ecology; **Charles R. Malone** (Ph.D., Rutgers University), a terrestrial ecologist with interest in decomposition processes and the effects of pesticides on terrestrial ecosystems; **Woodrow G. Strook** (M.S., Clemson University), a forester who is in charge of timber management on the 38,000-acre AEC Reservation; **Gerald U. Ulrikson** (Ph.D., University of Michigan), an aquatic ecologist interested in fisheries biology and the effects of pollution on fish populations; and **Robert I. Van Hook** (Ph.D., Clemson University), an invertebrate ecologist with interests in food chain mechanisms, radiation effects on insects and ecosystem analysis.

About Institutions

J. T. Spencer, Executive Director of the **Organization for Tropical Studies** (administered from the University of Miami, Coral Gables, Florida), has announced installation of \$100,000 worth of remote sensing equipment in the 1,400-acre Finca La Selva and the newly-leased field station on the Hacienda Palo Verde in Costa Rica. A main center telemetering console will be located at San Jose. The project is part of an ecosystem comparison study as is sponsored by the NSF and Ford Foundation.

The Biology Department of the University of Alabama, Tuscaloosa, is offering an expanded curriculum in biochemistry and physiology. Five new staff and requisite equipment have been added in the past two years.

NSF has awarded a grant of \$33,834 to **Troy State University**, Troy, Alabama, for a Cooperative College-School Science Program to be conducted during the summer of 1970. **James C. Wilkes**, Professor and Chairman of the Department of Science, is director of the program.

Troy State University, Troy, Alabama has been awarded a grant of \$18,359 by HEW for improvement of courses in Sanitary Science and Medical Technology. **D. C. Widdowson**, Professor of Biology, is coordinator of the program.

3786

The ASB

BULLETIN

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October 1970



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THE NATIONAL BUREAU
OF NATURAL HISTORY

A scanning electron
micrograph of the pollen
of *Vernonia fasciculata*
(Compositae). The diameter
of the pollen grain is ca 50 μ .
(Micrograph by S. B. Jones)

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The Association of Southeastern Biologists*

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CONTENTS

A Preliminary Analysis of A.S.B. Questionnaires —

Summer School Salaries. — David J. Cotter 99

The Philosophy of the Conceptpak Approach to Teaching

Biology. — David D. Husband 101

Two Year Biology Curriculum for Biology, Preprofessional

and Biology Education Majors. — S. K. Ballal 103

Association Affairs

109

Books & Periodicals

111

News of Biology in the Southeast

112

Future Meeting Sites

1971 — University of Richmond 15 - 17 April

1972 — University of South Alabama 6 - 8 April

1973 — Western Kentucky University 12 - 14 April

A Preliminary Analysis Of A S B Questionnaires - Summer School Salaries

DAVID J. COTTER
Georgia College

Approximately 350 questionnaires were returned in time for processing. Most of the data is now being analyzed and it is anticipated that a final report on salaries of the southeast will be available for the next issue of the *A. S. B. Bulletin*. This report deals with summer salaries because of the many confounding problems associated with the treatment of summer school data. There were 218 respondents who indicated summer employment. The average compensation was \$2,419.00.

As would be expected summer salaries vary considerably from one institution to another throughout the southeast. A definitive study of the data could not be made because of its inherent variability and the failure of a number of the respondents to provide specific data. Another confounding factor is the length of the summer term at the different schools as well as the failure to indicate the number of summer terms available (one or two). Additionally since the questionnaire did not request information about the specific school where the respondent was located it was impossible to eliminate duplications from the same institutions. Some people also failed to indicate whether they did not teach summer school by choice or simply because no opportunity was available.

However, some basic information could be obtained from the questionnaires returned. If summer salary is based on a percentage per course, faculty members were most commonly granted 10%/course and only occasionally 8%. Percentage compensation for full time work during the summer ranged from 10 to 33%. The most common figures were 20% (17% frequency), 16.7% and 25% (each 14%). Some schools paid up to a maximum figure which ranged from \$1,600 to \$4,000, but a stated maximum salary was not indicated on most questionnaires. One school utilized $1/39$ of annual salary multiplied by the number of hours taught, while another multiplied $1/39$ of the annual salary times the number of weeks taught. One school used $11/39$ of the annual base pay for full-time summer salary, another used $2-1/2\%$ per week, while still another paid 67% of the monthly salary during summer school. In a few cases summer salaries were entirely negotiated or based upon student enrollment.

In only one instance reported was laboratory work recognized in that \$800 base was paid for a course and supplemented by \$400 if a laboratory was taught with the course. This particular observation is noteworthy since it is the only program reported which recognized the peculiar na-

ture of the sciences in the necessity of teaching laboratories.

There were several approaches used where rank not salary was the criterion used for summer compensation. Additionally a few also reported a flat rate per course regardless of rank or annual salary. These are presented in Table I. Again no specific comparison can be made due to lack of differentiation in the number of weeks of the summer term or the difference in the quarter or semester systems.

In general the course load for the scientist during summer school fails to recognize laboratory assignments and is based upon credit hours or number of courses. In other words, those biologists who teach laboratory courses are carrying a heavier contact load during the summer than the personnel of non-science departments although their compensation levels are the same. This is quite often not the case during the academic year where teaching loads are based on other considerations. For example, the regular assignment for an academic term might be a multisectioned course (i.e. Microbiology) with two lectures and two laboratory sections, each with 3 two-hour labs/week which would amount to 14 contact hours per week. In a non-science area a normal load might consist of 3 five-hour

courses (15 hours of contact in lecture). During summer school the non-science teacher may receive 10% per course and be allowed to teach two courses for a 20% summer supplement (this would be 2/3 for normal load). On the other hand the science person could anticipate either 10% for the microbiology course or at best 16% (allowing 10% for the basic course and a 2% rate for the three additional laboratories in the second section) for what amounts to a full load for the academic year. By the same token the non-scientist could earn 30% of annual salary by teaching a normal full load during summer school. This type of inequity seems to be well established in the summer school policies of regional institutions.

Although the questionnaire was designed specifically for teaching biologists in the southeast a number of the members who are professionally employed on research contracts or non-teaching assignments filled in the portions of the questionnaire appropriate to their status. One half of these respondents had some teaching experience at the college level and half had masters degrees and the other half had the doctorate. Their composite revealed 12.6 years experience, 24 papers published (at a rate of almost two a year) and an annual salary of \$14,444.

TABLE I—Range of salary compensations based on a fixed amount.

	Instructor	Asst. Prof.	Assoc. Prof.	Professor	All Ranks
Amount/hour	\$100- 200	\$ 120- 225	\$ 160- 250	\$ 190- 300	\$ 200- 250
Amount/course	500-1,000	600-1,050	700-1,100	800-1,200	500-1,000
Amount/term	850-2,200	1,100-2,700	1,000-3,200	1,600-4,500	1,200-3,600

The following courses, sponsored by the Tissue Culture Association, will be offered at the W. Alton Jones Cell Science Center, Lake Placid, N.Y. during 1971. In general, all courses are intended for persons holding the Ph.D., M.D., D.D.S. or D.V.M. degree. Qualified graduate students will be considered if space is available.

June 21 - July 9—Cell culture for the study of cellular aging. (sponsored jointly with National Institute of Child Health and Human Development)

July 12 - Aug. 6—Plant cell and tissue culture

Aug. 9 - Sept. 3—Animal cell culture (including some work with insect cells)

Sept. 27 - Oct. 8—Organ culture

For further details and application forms write to:

Dr. Donald J. Merchants, Director
W. Alton Jones Cell Science Center
P. O. Box 631
Lake Placid, N. Y. 12946

The Philosophy Of The Conceptpak Approach To Teaching Biology

DAVID D. HUSBAND

Department of Biology, University of South Carolina

Each discipline may be divided into various topics. This is very useful from a pedagogical point of view. Biology, for example, is usually taught as a series of "units," perhaps beginning with the concept of the cell and proceeding eventually to the principles of ecology. There are, of course, a number of alternative approaches to teaching biology (or any discipline for that matter), but regardless of the approach used, the teacher invariably "divides" the subject matter into sequential units, or concepts. Indeed, it could be said that all of Biology could be subdivided into small packets of information. The logical place to begin, however, is the freshman biology program and it is proposed that the philosophy of the audio-tutorial approach to teaching be combined with the belief that the subject matter of biology can best be taught as a series of small, discrete units properly sequenced to allow for a total meaningful learning experience. The units are "single-concept" in nature and vary as to length and difficulty. Because a unit may utilize a variety of instructional aids and modes of presentation, one might think of a unit as a package of information. For this reason I have chosen the term "conceptpaks" to identify individual units.

Currently, conceptpaks fall into one of three categories, modeled after the approach adopted at Purdue's Department of Biological Sciences. Each concept is assigned either to Plant Science, Animal Science, or is common to both. Thus, conceptpak C1, "How to Use the Microscope" is common to both Botany and Zoology, conceptpak P2, "Seed Germination", belongs to Botany, and conceptpak A1 "Animal Diversity — Protozoans to Coelenterates" is clearly zoological.

Before further consideration of only a few of the numerous advantages of using the conceptpak approach, let me outline very briefly the basic philosophy of the audio-tutorial approach to teaching. Most readers of this paper will have a preconceived idea of what is meant when the phrase "A-T ala Postlethwait" is uttered. I am a disciple of Dr. Postlethwait's, having worked with him closely for 5 years as the Instructor in his Botany course at Purdue. I believe he is right when he says that "learning is done by the learner." It is an active process, not passive. The primary obligation of a teacher is to provide his students with clearly defined behavioral objectives which serve to guide their study, and then to create the most conducive environment for them to accomplish the objectives. It is the establishment of the proper Learning Center that has sometimes prompted the remark that A-T teaching means using tape recorders. There is nothing in the A-T Philosophy that dictates the use of tape recorders. The problem is to individualize instruction as much as possible — and to do this one needs access to a vehicle of communication which can stand a great deal more working hours than a human being. Of course, many other vehicles of communication are used in the Learning Center, each one chosen for its unique ability to get across certain ideas best.

The philosophy of audio-tutorial teaching is essentially the answer to a very fundamental question in pedagogy: "What are the basic activities and situations that allow for the most efficient learning to take place for my *individual* students?" The answer to this question will vary according to teachers' prejudices and prior experience, but I believe that there are some ingredients of a

good learning situation that are acceptable to all of us as conducive to learning. A few of these ingredients are outlined below.

It is unlikely that anyone would argue with the assertion that *concentration* is necessary in order to learn, yet the traditional classroom is often distracting. Many of the technological advances incorporate a carrel of some sort which is for the purpose of reducing distractions from the surrounding area. Also, the nature of many objectives requires *repetition* for their achievement, so we should place our students in an environment in which repetition can be adapted to the individual needs of the student.

Another important activity which enhances learning is the student making *associations* between what he is taught and actual specimens and other original materials that may be provided. If a science course lesson involves sedimentary rocks, then the student should have an example of sedimentary rock in his hand. The conventional classroom situation does not lend itself to allowing the student to make adequate associations with the subject.

People vary considerably in the amount of subject matter they can grasp in a given amount of time. Programmers have demonstrated that most people can learn almost anything if it is broken into small enough units and the student can take time to become informed about each unit before proceeding to the next. Is it not logical then that all programs of study should allow each student *an opportunity to adjust the size of the unit to his own ability*? Those who can absorb large quantities of information would be able to do so in an unrestricted fashion, whereas others who must proceed more slowly would be allowed to do so. This is an aspect of independent learning which is completely forgotten in the conventionally taught classroom.

It has been shown that some students learn best by reading, others by hearing, and others by seeing. I believe that it is the teacher's job to provide the means by which all kinds of students can learn best. The Audio-Tutorial System provides the opportunity for *subject matter to be presented in a variety of ways*. The student is free to exploit the medium which best suits him.

There are many handicaps to sequencing and integrating subject matter when the conventional lecture-laboratory course structure is used. This task is made much easier when the structure of the A-T System is employed. No longer are students exposed to a lecture on Monday, a related experiment on Wednesday, and a recitation on Friday. Instead, the events which occur in these separate sessions are brought together and integrated in the Independent Study Session.

Among the chief advantages the conceptpak approach will provide is greater flexibility in the course offerings to the students. It is conceived that eventually there will be hundreds of conceptpaks (currently there are about 40), and it is likely that a pharmacy student may complete a different series than a history major. Of course, there will be certain "basic" requirements, but after those are completed, individualized programs can be designed.

Conceptpaks will also provide a mechanism for requiring "mastery" of the subject matter before one is allowed to proceed to subsequent lessons with a prerequisite. At the end of a semester an individual would receive a grade on only those conceptpaks he satisfactorily completed. Therefore, if he had only completed, say, one-half of the normal load, he would receive a grade of "C" or above, but earn only 2 semester hours of credit in Biology instead of the normal four. The idea of "learning for mastery" is discussed by Bloom in an article published by the Center for the Study of Evaluation of Instructional Programs, UCLA, and the following quotation summarizes his viewpoint.

"Most students (perhaps over 90 percent) can master what we have to teach them, and it is the task of instruction to find the means which will enable our students to master the subject under consideration. Our basic task is to determine what we mean by mastery of the subject and to enable the largest proportion of our students to attain such mastery.

"We have for so long used the normal curve in grading our students that we have come to believe in it. Our achievement measures are designed to detect differences among our learners, even if the differences are trivial in terms of subject matter . . . Administrators are often on the alert to control teachers who are 'too easy' or 'too hard' in their grading. A teacher

whose grade distribution is normal will avoid difficulties with administrators . . .

"There is nothing sacred about the normal curve. It is the distribution most appropriate to chance and random activity. Education is a purposeful activity. If we are effective in our instruction, the distribution of achievement should be very different from the normal curve. In fact, we may even insist that our educational efforts have been *unsuccessful* to the extent to which our distribution of achievement approximates the normal distribution."

Conceptpaks will be prepared by authorities in the field being presented. It is even conceivable that personnel outside the immediate University faculty could be acquired if necessary. The ring of authenticity of a conceptpak entitled "Ultra-structure of Stem Anatomy" prepared by Katherine Esau is impressive indeed.

Conceptpaks can be of a nature which would allow for their export to schools which have the desire to upgrade instruction but not the required financial resources. Eventually there could be a "library" established to disseminate units similar to the way films are distributed via A-V Departments in every major college and university.

There are probably many other favorable attributes of the conceptpak approach which could be listed, but the above will suffice. Needless to say, to initiate this approach will require a great deal more time and money than what is presently required in the conventional teaching program, but after the initial expenditure the conceptpak approach will probably require less staff time on a per student basis and at the same time be a greatly improved system of instruction.

Two Year Biology Curriculum For Biology, Preprofessional And Biology Education Majors.

S. K. BALLAL

Department of Biology

Tennessee Technological University

Cookeville, Tenn. 38501

A two year experimental curriculum is being tried in the Biology Department of Tennessee Technological University. The sequence, which begins at the freshman level, is broken down to six subject areas for convenience in handling in six quarters, and this can be very easily modified to fit an appropriate semester sequence. The emphasis is not on any one subject unit like Botany, Zoology, etc., but on Biology as one complete and inseparable discipline. Beginning with the molecular and cellular level the various subjects of Biology are discussed through physiology, molecular and general genetics, and topped off with the

study of interactions of all these with the environment in which the organisms and groups of organisms live and their evolutionary and behavioral traits. There is a definite deviation from the "classical" approach to Biological education, which is in consistence with the developments and discoveries in the field of Biology, and this should satisfactorily meet the needs for a complete and comprehensive education in the field of Biology. It is realized that this curriculum by itself will be inadequate for students desirous of pursuing Biology or biologically oriented science as a profession, and the departments of Biology must constantly

endeavor to revise, modify and update the upper division courses. The syllabi presented below do not offer any supporting laboratory exercises, and this can be very easily planned and prepared depending on the availability of manpower and resources of the department concerned. It should be emphasized, however, that all areas covered must be adequately supported by laboratory training where each student should be personally involved in carrying out the assigned work under the expert guidance of faculty members.

Course *	Title	Credit (hrs.)*
111	Organismic Biology I	4
112	Organismic Biology II	4
113	Cell Biology	4
211	Genetics	4
212	Environmental Biology	4
213	Evolution and Behavior	4

* The course number and credit hours should be modified to meet the local institutional needs.

BIOLOGY 111 ORGANISMIC BIOLOGY I CREDIT 4 QTR. HRS.

1. Biology as a Science
 - a. Concepts, hypothesis and theories.
 - b. Importance of biological knowledge.
 - c. Chemical bonds, atoms, molecules and chemistry of biological reactions.
2. Cell Structure (elementary)
 - a. History of cell theory.
 - b. Organization:
 - Cell membrane, cell wall, nucleus, cytoplasm and organelles.
3. Cellular Function (elementary)
 - a. Metabolism:
 - Energy accumulation, expenditure and utilization.
4. Cellular Reproduction
 - a. Mitosis.
 - b. Meiosis.
5. Cellular Differentiation
 - a. Plants, and Animals:
 - Tissues and tissue organization.
6. Cell Specialization
 - a. Morphogenesis in plants and animals.
 - b. Genetic control.
 - c. Interrelationship between ontogeny and phylogeny.

BIOLOGY 112 ORGANISMIC BIOLOGY II CREDIT 4 QTR. HRS.

1. Organismic Reproduction
 - a. Alternation of generations.
 - b. Significance of haploid and diploid stages.
 - c. Asexual and sexual reproduction.
2. Reproductive Cycles in Plants *
3. Reproductive Cycles in Animals *
 - Eg. Protozoa, Annelids, Arthropods, Hemichordates and Chordates.
4. Classification of Organisms
 - a. Principles of Taxonomy.
 - b. Binomial system of nomenclature.
5. Organismic Maintenance
 - a. Digestion.
 - b. Assimilation.
 - c. Transportation in plants and animals.
6. Organismic Control
 - a. Respiration.
 - b. Secretion.
 - c. Excretion.
 - d. Hormones and regulators in higher plants and animals.
 - e. Chemical coordination.
 - f. Nervous control:
 - Nerve impulse, nerve connections, nervous system and response.

* Modifiable depending on the needs of students and availability of materials for the laboratory.

By the time this two quarter sequence is completed the student must be able to meaningfully analyze the various processes of organisms and how they are controlled. A little background of chemistry should provide the foundation for future explorations of organismic functions. The main theme should be begun with discourses on what constitutes life rather than what is life. The student must be impressed upon the fact that for total understanding of life processes certain topics in chemistry are to be understood, and these topics should include covalent, ionic and hydrogen bonding, chemistry of water, equilibrium of chemical reactions, redox systems and Van der Waal's forces. To accomplish this goal introductory

Chemistry courses should precede the Biology course or should be taken concurrently. The idea is not to expect the student to possess a mastery of the subject of chemistry before entering the realm of Organismic Biology, but to provide the ground work for better understanding of organismic cybernetics. The topics begin with the basic

units of all living systems. For the students who are excited about the living world around them, an understanding of homeostasis at a very early stage of career will be of great help to study organismic interplay, ecological relationships, population dynamics and behavior which will follow this sequence.

BIOLOGY 113

CELL BIOLOGY

CREDIT 4 QTR. HRS.

1. Cytology
 - a. Introduction to microscopy:
 - Electron, phase, darkfield, light, etc.
 - b. Cell Theory, History and Structure:
 - Schwann's and Virchow's concepts
 - Cell organelles
 - Mammalian erythrocytes
 - Procaryotic organisms
 - Bacterial cell
 - Viruses
 - Nucleus
 - Cell wall and membrane
 - Cytoplasmic inclusions
 2. Physical and Chemical Aspects
 - a. Energy
 - Laws of Thermodynamics and living systems.
 - Concept of free energy.
 - Ionizing radiation and its effects.
 - b. Physical and Chemical Principles
 - Diffusion, osmosis and imbibition.
 - Plasmolysis and plasmoptysis.
 - Cyclosis.
 - Properties of water, solutions and buffer systems.
 - c. Measurement of Physical Phenomena
 - Methods of pH measurements.
 - Spectrophotometry.
 - Use of osmometer, hydrometer, etc.
 3. Chemical Composition
 - a. Cell fractions
 - Structure, classification and properties of amino acids.
 - Water and salt content of cells.
 - b. Chemical tests
 - Carbohydrates, fats and proteins.
 - Electrophoresis.
 - Chromatography.
 - c. Membranes and permeability
 - Methods of measurements.
 - Pinocytosis and phagocytosis.
 - Active and passive transport.
 - Carrier hypothesis.
 4. Structure of Macromolecules
 - a. DNA
 - Structure and composition.
 - Base pairing.
 - Nuclosides and nucleotides.
 - X-Ray diffraction.
 - b. RNA
 - Structure and properties of ribosomal, transfer and messenger RNA.
 - c. Proteins
 - Primary, secondary and tertiary structures and analysis.
 - Peptides.
 - Denaturation of proteins.
 - d. Carbohydrates, Lipids and Pigments
 - Starch, glycogen and cellulose structure.
5. Synthesis of Macromolecules
 - a. Concepts of biosynthesis
 - b. DNA
 - Replication *in vitro* — Kornberg system.
 - Semiconservative replication — Meselson and Stahl system.
 - c. RNA
 - Synthesis, RNA polymerase.
 - d. Amino acids
 - End-product inhibition.
 - e. Proteins
 - f. Carbohydrates
 - g. Lipids
6. Enzymes
 - a. Induction
 - b. Kinetics
 - Activation energy.
 - Enzyme and substrate concentrations.
 - c. Structure and Function
 - Mechanics of catalysis.
 - Enzymes in organelles.
 - Factors affecting enzymatic activity — temperature, pH, etc.
7. Photosynthesis
 - a. Electromagnetic radiation
 - b. Photolysis
 - c. Carbon fixation
 - d. Photosynthetic phosphorylation
 - e. Efficiency
8. Respiration
 - a. Oxygen consumption and carbon dioxide release.
 - b. Glycolysis and Citric acid cycle.

- c. Anaerobic respiration.
- d. Oxidative phosphorylation and energy conversion.
- e. Respiratory movements and control. Eg. in man, insects and fish.
- f. Measurement.

- 9. Nutrition
 - a. Autotrophic.
 - b. Chemotrophic:
 - Saprophytism and parasitism.

BIOLOGY 211

GENETICS

CREDIT 4 QTR. HRS.

1. Introduction to Genetics
 - a. Definition and history.
 - b. Pre-Mendelian concepts.
 - c. Mendelian concepts.
2. Fundamentals
 - a. Mono- and dihybrid crosses.
 - b. Back cross and test cross.
 - c. Punnett square and branching process.
 - d. Concepts of linkage.
 - e. Meiosis and Mendel's laws.
3. Exceptions to Mendel's laws
 - a. Sex chromosomes:
 - Sex determination and linkage.
 - b. Incomplete dominance.
 - c. Multiple alleles.
 - d. Pleiotropism.
 - e. Gene interaction.
4. Crossing Over
5. Chromosome mapping

6. Nucleic Acid and Proteins
 - a. Structure of DNA and RNA.
 - b. Replication.
 - c. Structure of proteins and their synthesis controlled by nucleic acids.
7. Gene Function
 - a. Metabolic pathways.
 - b. Genes and enzymes.
8. Mutation
 - a. Gene mutation.
 - b. Structural alterations.
 - c. Changes in chromosome numbers.
9. Extranuclear inheritance
10. Population Genetics
 - a. Gene frequencies in natural populations.
 - b. Changes in gene frequencies.
11. Quantitative inheritance
12. Heredity vs. environment
13. Genetics and man

BIOLOGY 212

ENVIRONMENTAL BIOLOGY

CREDIT 4 QTR. HRS.

1. Introduction
 - a. Origin of Life.
 - b. Biological Organization:
 - Atom-molecule-organelles-cell-tissue-organ-organ system-organism-population-community-ecosystem-biosphere-universe.
 - c. History of Environmental biology.
 - d. Sub-disciplines and importance to man.
2. Ecosystem Concept
 - a. History.
 - b. Components and organization.
 - c. Trophic relationships:
 - Energy flow, biogeochemical cycles and efficiency.
 - d. Succession:
 - Plant — to climax
 - Animal — to biociation
 - Ecological equilibrium.
3. Limiting Factors
 - a. Liebig's Law of the Minimum.
 - b. Shelford's Law of Tolerance.
 - c. Scale of tolerance with subsidiary principles.

- d. Physical factors limiting major groups:
 - Plants, invertebrates, fishes, amphibians, reptiles, birds and man.
4. Populations
 - a. Density.
 - b. Emigration, immigration and migration.
 - c. Age composition.
 - d. Birth and death rate.
 - e. Growth rates:
 - Exponential and Sigmoid growth forms.
 - f. Cyclic populations.
 - g. Regulatory factors:
 - Dependent, independent, stabilizing and limiting factors of density.
5. Relationship between Organisms
 - a. Interspecific:
 - Symbiosis, commensalism, mutualism, parasitism, predation and competition.
 - b. Intraspecific:
 - Competition, aggregation and societies.
6. Ecological Niche Concept
 - a. Habitat and niche.

- b. Characteristics of niche.
- c. Niche segregation and speciation.
- 7. Biomes
 - Biomes of North America:
 - Climate
 - Topography and soils
 - Characteristic plants and their adaptations
 - Characteristic animals and their adaptations.
- 8. Current Environmental Problems
 - a. Problems defined by cause, magnitude, attempts at solution, and consequences.
 - b. Discussion:
 - Food production, crowding, energy usage and depletion of fossil fuels, urban and rural

pollution, environmental deterioration, population increases and natural areas and wild organisms.

By the end of this course, the students will be in a position to appreciate the intricacies of living organisms and their ability to succeed or fail as species. They will have a clear concept of the complexity of relationship between groups of organisms and their environment, helping them to appreciate the subject of speciation and behavioral patterns of living beings, which will be the topic of discussion in the next course.

BIOLOGY 213 EVOLUTION AND BEHAVIOR CREDIT 4 QTR. HRS.

A. EVOLUTION

1. Introduction
 - a. What is evolution?
 - b. Types of evolution.
 - c. Scopes and aims of the subject.
 - d. Theories of origin of life.
2. Darwinian Concept
 - a. Pre-Darwin ideas.
 - b. Darwin's Theory.
 - c. Evidences:
 - Geographical distribution
 - Comparative anatomy and embryology.
 - d. Objections to Darwin's Theory.
3. Post-Darwin Developments
 - a. Geological Record:
 - Geologic time scale, fossils and fossil dating methods.
 - b. Biochemical Evidence:
 - Immunology, electrophoresis and amino acid sequences.
 - c. Other Evidences:
 - Industrial melanism, resistance to antibodies and insecticides.
4. Evolutionary Forces
 - a. Genetic variability:
 - Mutation, recombination, hybridization, changes in chromosome morphology and number.
 - b. Selection.
 - c. Balanced polymorphism.
 - d. Genetic drift.
5. Evolutionary Trends
 - a. Adaptive radiation.
 - b. Specialization.
 - c. Divergence.
 - d. Convergence.

- e. Species concept and speciation.

6. Evolution of Man

- a. Controversy.
- b. Evidences.
- c. Future of man as a species.

B. BEHAVIOR

1. Introduction
 - a. History of the subject.
 - b. Ethological Theory.
2. Behavioral Patterns.
 - a. Stimulus and response.
 - b. Methods of study.
 - c. Measurement.
3. Behavioral Processes
 - a. Orientation, taxis, kinesis.
 - b. Biological rhythms.
 - c. Migration and orientation.
 - d. Stereotyped behavior — instinctive and motivated.
 - e. Learning — imprinting and classical conditioning.
 - f. Complex processes and reasoning.
4. Behavioral Control
 - a. Neural control.
 - b. Endocrine control.
 - c. Genetic control and behavioral genetics.
 - d. Pheromones.
5. Behavioral Expression
 - a. Social behavior.
 - b. Agonistic behavior.
 - c. Reproductive behavior.
 - d. Communication.
6. Biological Spectrum of Behavior
 - a. Ecology and behavior.
 - b. Taxonomy and behavior.
 - c. Evolution and behavior.

The student should be impressed upon the fact that man as a species is influencing his own evolution and the evolution of other species by his judicious and injudicious treatment of the environment. Many of the social problems taxing the sanity of man can be shown to be biologically oriented, and these problems show certain resemblances to what one finds among animals that have phylogenetic relationship with him. Hypostatic examples of this could be found in many behavioral patterns such as aggression, territorial imperative, sexual foreplay etc. It is hoped that, upon completion of the sequence and the last course in particular, the

student will have had a glimpse of the essential unity of biological science. A unity of ideas arising from the understanding of the techniques and principles from all branches of biology will help the student to explain and appreciate what a living organism does, how and why. Darwinian theory of evolution placed great stress on the idea of progressively improved adaptation; and the adaptation of an organism is largely reflected through its behavior.

I acknowledge with thanks the help rendered by my colleagues in the preparation of this work.

Stanley Auerbach To Head Ecological Sciences Division

A new Ecological Sciences Division was formed this week at Oak Ridge National Laboratory to place special emphasis on understanding the balances of nature and the dangers of pollution.

Alvin M. Weinberg, Director of ORNL, said the new Division will be directed by Stanley I. Auerbach, who has headed ecological studies since they first became a part of the ORNL program in 1954.

Until this week, ecological studies were a part of the Health Physics Division. Weinberg said the new Division will report to James L. Liverman, newly appointed ORNL Associate Director for the Biomedical and Environmental Sciences.

Auerbach said the new Division will have a key role in the International Biological Program. He said the Division will have charge of analyses of ecosystems in the eastern United States.

Initially, he said, the new Division will consist of approximately 50 persons, most of whom are specialists in various fields of ecology.

Auerbach said the new Division will be divided into two general groups, those engaged in studies of ecology of water and of land. Among planned areas of study: thermal effects on water and the life in it; radiation and chemical effects on plant and animal life; use of large-scale computer systems in determining the balances of nature and the earth's ecosystem; and the movement of pollution materials through food chains.

The new Director said the Division will also take a long, close look at the capacity of the

earth's vegetation to consume carbon dioxide and produce oxygen. This study, he said, results from the opinion voiced by some scientists that we may be dooming ourselves by destroying too much of the earth's vegetation.

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ASSOCIATION AFFAIRS

IVEY F. LEWIS FELLOWSHIP AT MOUNTAIN LAKE BIOLOGICAL STATION

A Research Fellowship of \$150.00 for summer course study or research at Mountain Lake Biological Station of the University of Virginia has been continued through the generosity of the Phipps and Bird Company of Richmond, Virginia. This fellowship, formerly known as the *Phipps and Bird Research Fellowship*, was re-named at the request of the Phipps and Bird Company. Any member of the Association may submit an application. The application should be accompanied by a summary of the planned work, by a list of important publications, and especially in the case of younger workers, by references and educational data. Applications should be sent to *Dr. J. J. Murray, Dept. of Biology, Univ. of Virginia, Charlottesville, Virginia 22903* not later than 1 March 1971. The announcement of the recipient will be made at the annual meeting of the ASB.

SUGGESTED NOMINEES FOR ASB OFFICES AND EXECUTIVE COMMITTEE POSITIONS

To the members of the Nominating Committee:

I wish to suggest that you consider the following ASB members in selecting nominees for offices and executive committee positions:

PRESIDENT-ELECT
VICE-PRESIDENT
TREASURER
EXECUTIVE COMMITTEE MEMBERS (2 for 3-year
terms)

Deadline: December 15

MAIL TO: DR. JOHN CARPENTER
Dept. of Zoology
University of Kentucky
Lexington, Kentucky 40506

MERITORIOUS AWARD NOMINATIONS

As in previous years, an honorarium of \$100. will be given as an award for the recognition of especially meritorious teaching by a member of the ASB. The regulations governing the award are as follows:

The recipient must be a member of the ASB in good standing. He should have taught biology in a southern institution for at least ten years, and must be currently teaching. He must not be a dean or have regular administrative duties beyond the department level (this particular criterion requiring interpretation in individual cases). Among evidences of his qualifications is the progress of the candidate as indicated by recognition in his own institution (important assignments and other contributions specifically related to good teaching); and the number and quality of students for whom he provided primarily the inspiration to continue in biology, especially those who later received advanced degrees.

Past recipients of the Meritorious Award for Teaching are as follows:

- 1952. Dr. Mary Stuart MacDougall (Agnes Scott)
- 1953. Dr. Orland E. White (Univ. of Virginia)
- 1954. Dr. Woolford B. Baker (Emory)
- 1955. Dr. John N. Couch (Univ. of North Carolina)
- 1956. Dr. Hugo L. Blomquist (Duke)
- 1957. Dr. Ezda Deviney (Florida State)
- 1958. Dr. Henry R. Totten (Univ. of North Carolina)
- 1959. Dr. Margaret Hess (Winthrop College)
- 1960. Dr. Ora. C. Bradbury (Wake Forest College)
- 1961. Dr. Warren Deacon (Vanderbilt)
- 1962. Dr. Septima C. Smith (Univ. of Alabama)
- 1963. Father Patrick H. Yancey (Spring Hill College)
- 1964. Dr. Ruskin S. Freer (Lynchburg College)
- 1965. Dr. Harwell P. Sturdivant (Western Maryland College)
- 1966. Dr. Charles Ray, Jr. (Emory Univ.)
- 1967. Dr. H. J. Oosting (Duke University)
- 1968. Dr. Wade T. Batson (Univ. of South Carolina)
- 1969. Dr. William L. Mengebier (Bridgewater College)
- 1970. Dr. Elton C. Cocke (Wake Forest University)

In these times in which so much is heard about teaching, it is particularly important that excel-

lence in teaching should be rewarded and publicized in every way possible. Members of the ASB are urged to make nominations and send the needed supporting material to *Dr. Jack H. Fehon, Dept. of Biology, Queens College, Charlotte, North Carolina 28207, by January 15, 1971.*

COMMITTEE

STUART BAMFORTH
WILLIAM MENGBIER
JACK H. FEHON, *Chairman*

TRAVEL AWARDS FOR GRADUATE STUDENTS

For the fourteenth year there will be funds available for assistance to graduate students for expenses in connection with the annual ASB meetings, to be held this year at the John Marshall Hotel, Richmond, Virginia, and hosted by the University of Richmond. Approximately \$300 will be available, and it is anticipated that most of the awards will be for maintenance (lodging and meals), and departments are urged to provide travel allowances for their graduate students or to invite them to travel in cars with staff members. Some travel allowances may be awarded by the committee to those living most distant from Richmond.

Staff members are requested to call to the attention of qualified students in their respective institutions the availability of these awards. If there is more than one applicant from a department, the Committee may request the department to aid the committee's selection by ranking the applicants.

Any graduate student needing financial assistance in order to attend the 1971 meeting of the Association of Southeastern Biologists is eligible. Rules for making application for the awards are as follows:

1. Indicate if application is being made for maintenance or travel or both. Give details, such as total sum requested, how many nights and days are involved, if travel allowance is requested, the number of miles involved and the proposed method of transportation, and any other pertinent information.
2. Give information as to whether or not a paper is being presented by the applicant.

3. In a paragraph, give a brief history of your education to date, of how many years you have been — and plan to be — in graduate school, of your major field or fields of interest, of any publications which have appeared or which may be in preparation, and any other pertinent professional details. Give information on marital status and number of children.
4. Give your source or sources of support while in graduate school such as G.I. Bill, N.S.F., N.I.H., teaching assistantship, etc.
5. Have your major professor or departmental head write a letter supporting your application.
6. Applications and supporting letters, both in triplicate, should be in the hands of *Dr. Frank Barclay, Dept. of Biology, East Tennessee State University, Johnson City, Tennessee 37601, by 1 February 1971.* Applicants will be notified of the decision of the Committee as soon as possible.

STEPHEN M. GITTLESON
CLARENCE STYRON
FRANK R. BARCLAY, *Chairman*

ASSOCIATION RESEARCH PRIZE

If you intend to present a paper at the annual meeting of the Association of Southeastern Biologists, we wish to call your attention to the Association Research Prize and invite you to submit your manuscript in competition. This prize of \$100. is sponsored by the Carolina Biological Supply Company, Burlington, North Carolina. Rules and regulations are as follows:

1. The Research Prize is to be awarded for an especially meritorious paper actually presented at the annual meeting.
2. Only members are eligible to submit papers in competition for the Research Prize. This applies to all names on the submitted paper.
3. Papers submitted in competition may be in press but must not have been published prior to March 1 of the year of the current competition.
4. Papers submitted in competition are judged by eminent scientists in the various fields of biology. These individuals are selected by the Research Committee and are from schools out-

side the Southeast. Every effort is made by the Research Committee to keep the authors of submitted papers anonymous. Criteria for the award are left to the discretion of the judges' panel, who may withhold said award if no paper is considered to have sufficient merit.

5. Papers must be submitted *in triplicate* and in their entirety not later than *February 1, 1971*, to Dr. Arthur W. Jones, Dept. of Zoology, Univ. of Tennessee, Knoxville, Tennessee 37916. One

copy of the prize-winning paper will remain in the ASB files, but all other copies will be returned to the authors as soon as possible.

6. Announcement of the winner of the Research Prize will be made at the annual meeting.

J. C. O'KELLEY

PAUL YOKLEY, JR.

ARTHUR W. JONES, *Chairman*

Books and Periodicals

STATISTICS AND EXPERIMENTAL DESIGN, Geoffrey M. Clarke. New York: American Elsevier Publishing Company, Inc. 1970. \$6.75, 161 pp.

In 136 pages of text this little book ranges from simple descriptive statistics through the poisson, binomial and normal distributions, to simple, randomized block, and 2^3 factorial analysis of variance designs. Each of the chapters has exercises, with answers and comments on the exercises at the end of the book. Calculus is not a prerequisite but elementary algebra and a readiness on the part of the student to be faced with a relatively rigorous symbolism is required. The book is written for biology students but reads like a statistician wrote it (which the author is). The book evolved, as most do, from the author's lectures and he reports the material successful with students in an honors biology course, presumably at the University of Sussex which is his present academic affiliation.

Since the material is rather tightly packed, the typical student will probably need considerable help, however, and the teacher will probably need some familiarity with advanced statistics—though not necessarily via the math-stat route. The treatment is in the classical Fisherian tradition, with only two non-parametric tests given any space: the Sign Test and the Mann-Whitney U-Test are covered in three pages. The only correlational technique covered is the Pearson r , Spearman's ρ being omitted. The only four tables are for Student's t , X^2 , F and r . Although the normal distribution is discussed the usual table of normal deviates is not given. The usefulness of the book will undoubtedly depend on the level of the student, which the potential teacher will have to judge for himself, and the readiness

of the teacher to do some fairly extensive "filling in" in class.—ROBERT C. BECK, *Department of Psychology, Wake Forest University.*

THE LIVES OF WASP AND BEES, Sir Christopher Andrews. American Edition Published by American Elsevier Publishing Company, Inc., 52 Vanderbilt Avenue, New York, N.Y. 10017. 204 pp., 32 photographs, 15 line drawings. 1969. Cloth \$5.75.

Sir Christopher Andrews has done a good job of describing the life habits of a large number of wasp and bees, which he classifies on the basis of some special characteristics; such as: spider-hunters, grasshopper-hunters, fly-catchers, bee-wolves, bug-hunters, mud-daubers, potter-wasp, etc. He stresses the adaptations for reproduction and provisioning for the developing larvae. Many of the solitary wasps prepare their brood-cells by burrowing into the soil, plant stems or wood, or by constructing them of mud or some other substance—mud-daubers, potter-wasps, paper-wasps. Food for the larvae of these is usually some specific arthropod—spiders, flies, cicadas, grasshoppers or bees. The prey is captured alive and immobilized by stinging it in the central nervous system. Sometimes the animal is further paralyzed by malaxation, that is chewing or massage of the neck region, which seems to damage the nervous system. The author describes how by these means food may be kept alive but immobile for two weeks or more, during which time the eggs hatch and the larvae develop by consuming the prey. Sir Christopher stresses the adaptations and instinctive responses of the wasps and bees along with the evolution of the group from primitive solitary insects to highly specialized social insects such as the honey-bees.

The book does not contain any new facts, but rather observations of many entomologists, and tells the story of the lives and habits of the wasps and bees in a fascinating way which can be easily understood and enjoyed by the layman without biological training. It should stimulate the interest of students from high school through college. At the end of each chapter the author gives the correct pronunciation of the generic and specific names used in the text. This is an excellent

feature, since many of the wasps and bees do not have common names and the inability to pronounce the Latin names might dampen the interest or deter the reader. At the end of the book is a fairly comprehensive list of references which should be very helpful to those wishing to study further the taxonomy and interesting life habits of the wasps and bees. — ELTON C. COCKE, *Department of Biology, Wake Forest University, Winston-Salem, North Carolina 27109.*

News of Biology in the Southeast

STATE CORRESPONDENTS

Alabama — Jack S. Brown, Florence State University; James Wilkes, Troy State University

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Georgia — Fred K. Parrish, Georgia State College

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Mississippi — Position Vacant

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Tennessee — Donald Caplenor, Tennessee Technical University

Virginia — Jean Pugh, Christopher Newport College

West Virginia — Earl L. Core, West Virginia University

Jean Pugh — Editor

Dept. of Biology
Christopher Newport College
Newport News, Virginia 23601

The Center for Urban Studies of the University of Miami, Coral Gables, Florida, and the Southern Florida Flood Control District were co-sponsors of an Everglades Conference in Miami 26-28 February 1970. The conferees included faculty members of several colleges and universities, government scientists, representatives of conservation groups and students. Discussions on scientific aspects of the Everglades and its problems were followed by an urban center workshop which considered aspects of man's relationship to the Everglades. More than 200 persons participated in the conference.

The University of Miami, Coral Gables, Florida, has established a new "exchange" program with the University of Guyana which involves the biology departments of both universities. The program was initiated last Spring when a contingent of faculty, graduate students and undergraduates headquartered themselves at Dawa on the northwest coast of Guyana; from there they established satellite field stations in the area. Financial aid was provided by the participants, the University of Miami and a biomedical sciences support grant from NIH. The Guyanese government provided the facilities and material support. Arrangements were made through the Agency for International Development (AID) as a part of the cooperation engendered by the Association of Caribbean Universities, of which the University of Miami is a founding member.

The University of Miami, Coral Gables, Florida, has opened a new field station in Everglades National Park. The station, with a dormitory for 18 people and other appropriate buildings, is envisioned as a parallel to the

Pigeon Key Station but concerned with the tropical interior. Ronald H. Hofstetter, Assistant Professor of Biology, is director of the new station. Individuals or groups wishing to use the facilities should contact Dr. Hofstetter (P.O. Box 9118, University of Miami, Coral Gables, Fla. 33124) stating the use to which they plan to put the station.

The University of Florida (Gainesville) Faculty of Parasitology has openings for predoctoral students under a Training Grant from the National Institute of Allergy and Infectious diseases. The students major in any of the various phases of parasitology ranging from taxonomy to parasitic diseases and the various aspects of host response. Financial support is also available in departmental assistantships. For further information contact Dr. Richard E. Bradley, Sr., Program Director, Dept. of Veterinary Science, University of Florida, Gainesville 32601.

Wofford College has received a \$295,000 grant from the National Science Foundation. The grant is the largest ever received by a private college in South Carolina for a curriculum program.

The grant will be used to strengthen the experimental sciences at Wofford including biology, chemistry, geology, physics, and psychology. Dr. B. G. Stephens of Wofford's Department of Chemistry will be director of the grant. Dr. W. Ray Leonard, Chairman of the Biology Department, was chairman of the six man committee that submitted the proposal for the grant to the National Science Foundation.

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The ASB

BULLETIN



Volume 18, Number 1
January 1971

In This Issue

**Advance Information About
The Richmond
Meeting**

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THE AMERICAN SOCIETY
OF NATURAL HISTORIANS

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University of Richmond

*The Official Quarterly Publication of
The Association of Southeastern Biologists*

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C. W. HART, JR.
EDITOR

MARGARET GILBERT
Associate Editor
JEAN PUGH
News Editor

DAVID J. COTTER, Business Manager

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John D. Withers (1973), CUEBS, Washington

All officers are ex officio members of the executive committee.



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Franklin F. Flint (1973), Randolph Macon Woman's College

AAAS Representatives —
John D. Withers (1970), CUEBS, Washington, D.C.
B. T. Cole (1971), University of South Carolina

CONTENTS

Association Affairs	2
About the Richmond Meeting	3
News of Biology in the Southeast	7

ASSOCIATION AFFAIRS

Proposed Changes In The By-Laws Of The ASB

The following proposed changes in the By-Laws of the Association of Southeastern Biologists were presented to the Executive Committee at its interim meeting on 24 October 1970, and were approved for presentation to the members at the annual business meeting on 16 April 1971. At that time the changes will be voted on.

The By-Laws as they now stand are presented below first, with words to be deleted in *italics*. The proposed modified version follows, with proposed additions in **bold-face** type.

Present

ARTICLE III. Duties of Officers

Section 1. The President shall be the directing officer of the Association, shall perform the duties usual to that office, and shall appoint, with the advice of the Executive Committee, regular committees, special committees authorized by the Executive Committee, and a representative to the American Association for the Advancement of Science. Also, he shall appoint such other special committees as may be required.

Proposed

ARTICLE III. Duties of Officers

Section 1. The President shall be the directing officer of the Association, shall perform the

(Continued on page 6)

The Association of Southeastern Biologists will hold its 32nd annual meeting April 15-17, 1971, in Richmond, Virginia. The University of Richmond will be host to the meeting. Accommodations, registration, and most events will be in the John Marshall Hotel in downtown Richmond. The General Session on Thursday evening will begin at 7:30 p.m. and will include an address by Dr. David E. Davies, president of the AIBS.

Following the program, a Social will be given under the sponsorship of Phipps and Bird, Inc.

In addition to the regular paper sessions on Friday afternoon, there will be a symposium on the "Recovery and Restoration of Damaged Ecosystems" (see below). The banquet on Friday evening will feature as speaker Dr. Robert R. Curry, Professor of Environmental Geology, University of Montana. Later that evening there will be the Scientific Products Social.

ABOUT THE RICHMOND MEETING

General Information

Richmond, the Capital of Virginia, is a city with over a half-million metropolitan population and is known as the "Tobacco Capital of the World." It is located on the fall-line of the James River between the Blue Ridge Mountains and the Chesapeake Bay. As a transportation gateway, Richmond is served by 5 railroads, 4 airlines, 2 major bus systems, 3 Interstate Highways, and the navigable James River. As an educational center, it has eight institutions of higher learning plus numerous museums and shrines of historic and cultural interest.

In addition to two downtown campuses, the University of Richmond has its main campus situ-

ated in the western limits of Richmond. There, its Gothic-styled buildings are spread over 350 acres of rolling lawns and woodlands. The university currently has a total enrollment of about 7,000 of which 3,000 are full-time students. It is the largest private university in the state and, as of last year, through the generosity of E. Clairborne Robins of the A. H. Robins Pharmaceutical Company in Richmond, it was placed among the highest endowed universities in the country.

The John Marshall Hotel in downtown Richmond offers a custom designed Convention Center. The hotel has 500 attractive bedrooms, fine dining facilities, and every service expected of one of the Nation's finest hotels.



Skyline of Richmond, Virginia

Registration

Convention Lobby of the John Marshall Hotel

Noon - 11:00 P.M. Thursday

8:00 A.M. - 5:00 P.M. Friday

Fee — \$2.00. *Be sure to bring your program with you.* Extra copies will be \$1.00.

Exhibits

Exposition Hall A — John Marshall Hotel

Noon - 5:00 P.M. Thursday

8:00 A.M. - 5:00 P.M. Friday — Courtesy coffee will be available in the Exposition Hall.

Paper Sessions and Symposium

Meeting rooms of the John Marshall Convention Center.

Symposium on the Restoration and Recovery of Damaged Ecosystems

Much attention has been given to the prophets of doom who are bewailing the fate of the planet, and the terrible things that are happening to the environment. However, little attention has been given to constructive and positive approaches to coping with environmental problems, either through deliberately restoring damaged ecosystems or relieving the pollutional stress sufficiently for them to recover by themselves. This symposium will deal with practical problems and case histories described and discussed by people who have worked with these real problems and case histories. The symposium is divided so attention is given to the overall problem in the keynote speech with three examples preceding the keynote speech in the afternoon session, one with terrestrial ecosystems, one with freshwater ecosystems, and a talk on estuarine ecosystems.

Friday afternoon session — this session will run from 2:00 to 5:00 and will consist of three papers of approximately 40-45 minutes each with 15 or 20 minute discussions to follow. The speakers for the afternoon session will be as follows:

1) Dr. Ronald D. Hill, Chief, Mine Drainage Pollution Control Activities, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati, Ohio 45226. Dr. Hill will speak on the Restoration of a Terrestrial Environment — The Surface Mine.

2) Dr. Thomas L. Linton, Commissioner, Division of Commercial and Sport Fishery, North Carolina Department of Conservation and Development, Raleigh, North Carolina 27602. Dr. Linton will talk about estuarine and dune problems.

3) Dr. John Cairns, Jr., Center for Environmental Studies, V.P.I., will talk on restoration and recovery of damaged stream systems.

Friday evening keynote speaker — Dr. Robert R. Curry, Environmental Geologist, University of Montana, Missoula, Montana. Dr. Curry will speak on soil destruction associated with forest management and other uses and prospects for recovery in geologic time.

Placement Service

The placement center will be available for listings and interviews:

Noon - 5:00 P.M. Thursday

8:00 A.M. - 5:00 P.M. Friday

Special Events

A *free* week-end for two in historic and beautiful Colonial Williamsburg — including accommodations Saturday night, April 17, 1971, in a Colonial House Inn, three meals in the Colonial Taverns of choice, and admission to all Colonial buildings. The name of the winner will be drawn from the slips of paid registrants at the Banquet on Friday evening.

Especially for the Ladies . . .

A luncheon and fashion show at noon on Friday, April 16. Cost \$2.75. Cocktails extra. Reservations requested.

Suggested activities also include:

Visits to near-by famous shrines, homes and museums. Among them:

the State Capitol, Lee House, White House of the Confederacy, the John Marshall House, St. John's Church, and the Virginia Museum of Fine Arts.

Visits to Richmond's most beautiful public and private gardens — just prior to Garden Week! Tours of the James River Plantations of romance and legend.

Visits to Colonial Williamsburg (an hour from Richmond), or to Washington, D.C. (an hour and a half away by Interstate).

Accommodations

Reservations for rooms in the John Marshall Hotel should be made through the local Committee by April 1, 1971.

The rates, exclusive of tax, are:

Single	\$15.50 - 21.50
Double or twin	20.50 - 26.50
Suites	49.00 - 61.00

Children under 12 free in parent's room. \$4.00 charge for each additional adult. Students 23 years of age or under at \$6.50 each, 3 to a room.

Students may also obtain rooms at the YMCA located five blocks from the John Marshall Hotel. The rate is \$5.02 per night and reservations must be made by March 15 to YMCA, 2 W. Franklin Street, Richmond, Va. 23219.

Every effort will be made to assign the type of room requested.

Parking

Ample free garage parking with quick delivery is provided by the hotel.

Dining

There are excellent dining facilities within the hotel and within walking distance. A list of suggested places for dining, dancing, or cuisine of various nations will be available in the Convention Lobby. Mixed drinks are available in the hotel and in most restaurants. Liquor by the bottle may be secured from a near-by State liquor store.

Banquet

The ASB Banquet on Friday evening will feature traditional Virginia foods including Smithfield ham, Chesapeake Bay crabs, Shenandoah apples and hot John Marshall spoon bread. Cost — \$7.50. Reservations requested.

Field Trips

Scheduled trips for Saturday, April 17:

1. Trip to the Western Shore of the Chesapeake Bay, Maryland, to visit the Calvert Cliffs Nuclear Power plant being constructed by the Baltimore Gas and Electric Co. A tour and explanation of facilities will be provided, fol-

lowed by a tour of the Benedict (Md.) Estuarine Laboratory of the Academy of Natural Sciences of Philadelphia. Transportation by chartered bus will be provided by the Baltimore Gas and Electric Co., leaving Richmond Saturday morning and returning Saturday evening. The only costs to participants in this trip will be food. Reservations should be made as early as possible through Dr. John Bishop, Dept. of Biology, University of Richmond, Richmond, Virginia.

2. Guided tour through the Dismal Swamp in Southern Virginia.

While in Richmond you may wish to visit:

The Virginia Oceanmobile which will be on display near the hotel.

The newly developed James River Park and bird walks.

The research labs of the Medical College of Virginia just a few blocks from the hotel. The Richmond Math-Science Center.

Various tobacco company plants and research labs.

Other Societies Meeting with the ASB

Southeastern Division, American Society of Ichthyologists and Herpetologists
Southeastern Section, Botanical Society of America
Southern Appalachian Botanical Club
Beta Beta Beta

Local Arrangements Committee

Willie M. Reams, Jr., Co-chairman
William S. Woolcott, Jr., Co-chairman
John W. Bishop
R. Dean Decker
William L. Kirk
Frank B. Leftwich
Nolan E. Rice
John C. Strickland, Jr.
Wilton R. Tenney
David W. Towle
Elizabeth F. Wells
Warwick R. West, Jr.

(Continued from page 2)

duties usual to that office, and shall appoint, with the advice of the Executive Committee, regular committees, special committees authorized by the Executive Committee, and representatives to the American Association for the Advancement of Science (AAAS) and The American Institute of Biological Sciences (AIBS). Also, he shall appoint such other special committees as may be required.

Present

ARTICLE IV. Dues and Fees

Section 1. The annual dues of the Association for Active Members shall be two dollars (\$2.00) for graduate and undergraduate students, four dollars (\$4.00) for regular members, five dollars (\$5.00) for contributing members, and twenty-five dollars (\$25.00) for sustaining members. Emeritus Members shall be exempt from dues.

Proposed

ARTICLE IV. Dues and Fees

Section 1. The annual dues of the Association for Active Members shall be two dollars (\$2.00) for graduate students, four dollars (\$4.00) for regular members, five dollars (\$5.00) for contributing members, and twenty-five dollars (\$25.00) for sustaining members. Emeritus Members shall be exempt from dues.

Present

ARTICLE VII. Regular Committees

Section 1. The following regular committees shall be appointed by the President upon the approval of the Executive Committee:

- A. Auditing Committee
- B. Nominating Committee
- C. Program Committee
- D. Resolutions Committee

Proposed

ARTICLE VII. Regular Committees

Section 1. The following regular committees shall be appointed by the President upon the approval of the Executive Committee:

- A. Auditing Committee
- B. Nominating Committee
- C. Research Awards Committee

- D. Meritorious Teaching Award Committee
- E. Travel Award Committee
- F. Place of Meeting Committee
- G. Local Arrangements and Program Committee
- H. Resolutions Committee
- I. Conservation Committee

Present

Section 2. The duties of the Regular Committees shall be as follows:

The Auditing Committee shall examine the records of the Treasurer prior to the annual business meeting of the Association and shall report the condition of the accounts to the membership at this meeting.

The Nominating Committee shall, with due consideration of suggestions received from the membership, prepare a multiple slate of nominees for each office or vacancy to be filled.

The Program Committee shall have the power to accept or to reject papers for the programs, and shall work with the Secretary in arranging the program.

Proposed

Section 2. Duties of Regular Committees shall be as follows:

Auditing and Nominating as presently given.

Research Awards Committee shall each year select a recipient of the Association Research Prize offered by Carolina Biological Supply Co.

Meritorious Teaching Award committee shall each year select a member of the Association to receive an award for meritorious teaching.

Travel Award Committee shall make monetary awards to assist graduate students to attend the annual ASB meetings.

Place of Meeting Committee shall recommend to the Executive committee the place where the annual meeting shall be held.

Local Arrangements and Program Committee shall make all arrangements for the annual meeting including receipt and scheduling of scientific papers to be presented.

Resolutions Committee shall formulate and present to the Association through the Executive Committee such resolutions as may be considered worthy of action by the Association.

Conservation Committee is to evaluate conservation problems, especially in the southeastern states, to make public resolutions of their own as individuals, or bring matters before the

membership at the annual meeting or by other means.

(A more formal charge to this committee will be prepared by April.)

News of Biology in the Southeast

STATE CORRESPONDENTS

Alabama — Jack S. Brown, Florence State University; James Wilkes, Troy State University

Florida — Harold J. Humm, University of South Florida

Georgia — Fred K. Parrish, Georgia State College

Kentucky — Gary E. Dillard, Western Kentucky University

Louisiana — Harry J. Bennett, Louisiana State University

Mississippi — Position Vacant

North Carolina — C. J. Umphlett, University of North Carolina

South Carolina — J. M. Herr, Univ. of South Carolina; G. Thomas Riggan, Jr., Newberry College

Tennessee — Donald Caplenor, Tennessee Technical University

Virginia — Jean Pugh, Christopher Newport College

West Virginia — Earl L. Core, West Virginia University

Jean Pugh — Editor

Dept. of Biology
Christopher Newport College
Newport News, Virginia 23601

About People

Clyde J. Umphlett has been appointed Chairman of Botany at Clemson University. Dr. Umphlett was formerly at U. of N.C. at Chapel Hill. Mr. C. R. Dillon is an Instructor of Botany at Clemson.

Edwin T. Hibbs, Professor, has been appointed Head of the Department of Biology, Georgia Southern College. Dr. Hibbs received his Ph.D. from Ohio State University and for the past several years has been teaching and conducting research in the Department of Zoology and Entomology, Iowa State University. His recent research interests are concentrated in the areas of the fundamental ecology of insect-plant interactions. Other new staff members in the Georgia Southern College Department of Biology are: Henry L. Curtis (Ph.D., Ohio State U.), Assistant Professor, who joined the faculty following the completion of his doctoral requirements in plant physiology; W. Keith Hartburg (Ph.D., U. of Notre Dame), Assistant Professor, an entomologist/geneticist who was formerly with the WHO East African *Aedes* Research Unit in Dar es Salaam, Tanzania; C. Selby Herrin (Ph.D., Ohio State U.), Postdoctoral Research Associate, who is working with James E. Oliver, Jr., Callaway Professor, on the statistical approaches to the intraspecific variation and speciation of ticks; John D. Pike (M.A., U. of Tennessee), Instructor, is an algal physiologist who is on a temporary teaching position; and Orrie O. Stenroos (M.S. North Dakota State U.), Assistant Professor, is a biochemical embryologist who is also on a temporary teaching position.

Two faculty members of Georgia Southern College are on a leave of absence. John R. Bozeman, Assistant Professor, has recently been awarded a NASA Fellowship to complete his doctoral studies at the University

of North Carolina at Chapel Hill. Mr. Bozeman is completing an ecological and floristic study at the sand ridge vegetation in the Atlantic Coastal Plain of Georgia. Wayne A. Krissinger, Instructor, is starting work toward a Ph.D. degree in microbiology at the Medical College of Georgia.

William D. Reese, University of Southwestern, Louisiana, Lafayette, has been named Editor of *The Bryologist*, quarterly journal of the American Bryological and Lichenological Society. Dr. Reese succeeds William L. Culberson, Duke University, who served as editor for the past eight years.

J. Richard Thomson is now with TVA's Division of Medical Services as Administrative Analyst in the Central Medical office in Chattanooga, Tennessee.

Martin Bordener has joined the staff of Agnes Scott College as instructor in botany. Mr. Bordener received his M.A. degree from Michigan State University.

Jessie F. Clovis, Associate Professor of Biology at W.V.U., attended the 17th Annual Systematics Symposium at the Missouri Botanical Gardens. The Symposium is funded by NSF and sponsored by the Gardens for 200 participants. This year's Symposium was in honor of Edgar Anderson. Dr. Ledyard Stebbins was the moderator.

Donald J. Barras has joined the staff of the Department of Biology, Troy State University, as Associate Professor of Biology. His primary teaching responsibility will be in physiology and molecular biology.

W. Newman Bradshaw, Department of Biology, West Virginia University, presented a paper, "Karyotypic modality among continental races of the deer mouse", at the Cell Genetics Conference in Galveston, Texas, on October 28, 1970.

Edwin A. Hess has joined the Department of Biological Sciences of Eastern Kentucky as its new chairman. Dr. Hess received M.S. and Ph.D. degrees from the Ohio State University. The former chairman, Dr. H. H. LaFuze, remains in the Department as Professor of Biology.

New additions to the Biology Faculty of Western Kentucky University include: Larry N. Gleason (Ph.D., 1969, Parasitology, University of North Carolina) and Martin R. Houston (Ph.D., 1969, Cell Physiology, Vanderbilt). Both men joined the Department as assistant professors after completing post-doctoral assignments at the University of Florida and Arizona State University, respectively.

Joseph C. O'Kelly, Professor, of the University of Alabama has been appointed as head of the Department of Biology. Dr. O'Kelly succeeds Hubert Schwartz who resigned his administrative duties to devote more time to teaching and research.

Sidney W. Fox, Kauro Harada and P. E. Hare of the Institute of Molecular Evolution at the University of Miami are authors of papers presented at the 1970 International Symposium on Hydrogeochemistry and Biogeochemistry meeting in Tokyo, September 6-12.

E. Spencer Wise, Assistant Professor, Christopher Newport College recently received his Ph.D. degree from the University of Illinois. David A. Bankes, Assistant Professor, and Lee C. Olson, Assistant Professor, have joined the staff of the Biology Department at Christopher Newport College.

Deceased

Marinus J. Dijkman, October 6, 1970. The M. J. Dijkman Memorial Fund, P.O. Box 109, South Miami, Florida 33143 has been established to support allied research in Oncology at the University of Miami School of Medicine.

Netta E. Gray, 58, Instructor in Botany, Agnes Scott College, 24th of August, 1970. Author of articles on morphology of numerous species of the genera *Pedocarpus*. A memorial book fund has been established in her honor in the Biology Library of Agnes Scott College.

About Institutions

The Department of Biological Sciences of Eastern Kentucky University has recently added a Fisheries Management degree to complement the existing Wildlife Management degree. New courses and a specially designed curriculum have been introduced in both fields for undergraduates, and graduate courses are also offered for the M.S. degree. Institutional research grants support staff research in a bio-ecological study of Kentucky River drainage, the source and fate of bac-

terial and chemical pollution in freshwater streams, a survey of internal parasites of freshwater fish, the effects of strip mine siltation on small stream fish, and sensory adaptation of stream fish.

David Davis Of AIBS To Speak To ASB At April Meeting

Dr. David E. Davis, President of the AIBS and Professor and Head of Zoology, North Carolina State University, will deliver the Keynote address at the 1971 meeting at Richmond, Virginia. On Thursday evening, April 15, he will speak on "Population Regulation in Animals," a topic very much in the news today.

A native of Chicago, Illinois, Dr. Davis received his B.A. from Swarthmore and his M.S. and Ph.D. degrees from Harvard. He spent 1940 in Argentina on a Harvard Traveling Fellowship and after one year as a Postdoctoral at the University of Chicago, he served as a zoologist for the Rockefeller Foundation in Brazil. He was a Senior Scientist with the U.S. Public Health Service (1943-1945); Assistant to Associate Professor, Johns Hopkins School of Hygiene and Public Health (1946-1959); Professor, Pennsylvania State University, (1959-1967). In 1967 Dr. Davis assumed his present position as Professor and Head of Zoology at N.C. State University.

Dr. Davis is a member of numerous professional and honorary societies. Among these are ASB, AAAS, American Society of Zoologists, American Society of Mammalogists, Ecological Society of America, Wildlife Society, American Ornithological Union, Wildlife Disease Association (President 1962) and the American Institute of Biological Sciences (President 1971). In addition, he has been Editor of both the *Wilson Bulletin* (1948-50) and *Animal Behaviour* (1957-61).

Dr. Davis has published two books, *Principles in Mammalogy* and *Integral Animal Behavior*, and over 200 papers on populations, behavior, and physiology.

The Association of Southeastern Biologists is privileged and proud to have one of its own members and the President of AIBS as our speaker for the annual meeting in 1971.

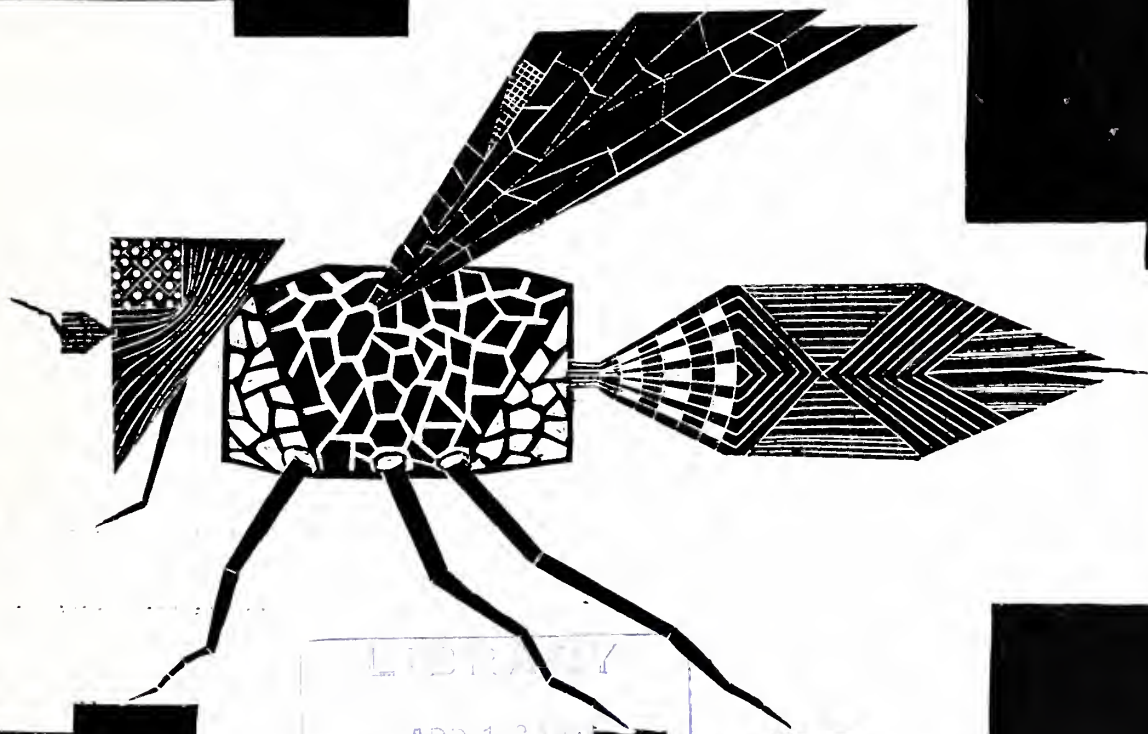
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The ASB

BULLETIN

Volume 18, Number 2

April 1971



Selwyn S. Roback

*The Official Quarterly Publication of
The Association of Southeastern Biologists*

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OFFICERS OF THE ASB

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CONTENTS

Program of the 32nd annual meeting of the ASB	11
University of Miami offers tropical botany seminar	23
University of Virginia announces Mountain Lake Program	23
Abstracts of papers presented at the 32nd annual meeting of the ASB	24
ASB candidates for offices — 1971	64
Treasurer's report — 1970	68
News of biology in the southeast	69
Books and periodicals	69
A resume of the Departmental Chairman's Meeting at the ASB meeting on April 2, 1970, at Florida Southern College, Lakeland. — Franklin F. Flint	72
Floor plan of the function floor of the John Marshall Hotel	74
Floor plan of the mezzanine floor of the John Marshall Hotel	75
Map showing approaches to the John Marshall Hotel in Richmond, Va.	76

Program of the 32nd Annual Meeting of the Association of Southeastern Biologists

John Marshall Hotel, Richmond, Virginia

University of Richmond, Host

A joint meeting with the Southeastern Section of the Botanical Society of America, the Southern Appalachian Botanical Club, Southeastern Division of the American Society of Ichthyologists and Herpetologists, and the Southeastern Region of Beta Beta Beta National Honorary Biological Society.

THURSDAY, APRIL 15

- | | |
|--|--|
| <p>12:00-11:00 Registration and Information: Convention Lobby.
Fees: Registration — Regular = \$2.00; Student = no charge.
Banquet — \$7.50. Deadline: Noon Friday, April 16.
Ladies Luncheon and Fashion Show — \$2.75. Deadline: 10:00 A.M. Friday.</p> <p>12:00- 5:00 Registration for Trips: Convention Lobby.
Placement Service: Monroe Room, Mezzanine.</p> <p>12:00- 5:00 Exhibits: Exhibition Hall, Convention Lobby.</p> <p>2:00 Executive Committee Meeting, Association of Southeastern Biologists: Byrd Room, Mezzanine.</p> | <p>7:30 P.M. A.S.B. General Session: Commonwealth Hall, Main Level.
Address of Welcome: Dr. Robert F. Smart, Provost, University of Richmond.
Response: Mr. C. W. Hart, Jr., President, the Association of Southeastern Biologists.
Invitational Address: Dr. David E. Davis, President, American Institute of Biological Sciences — <i>Self Regulation of Animal Populations</i>.
9:30 P.M. Social: Virginia Room, Convention Lobby. Sponsored by Phipps and Bird, Inc.</p> |
|--|--|

FRIDAY, APRIL 16

- | | |
|--|--|
| <p>7:00 A.M. Breakfast and Business Meeting for the Southeastern Section, Botanical Society of America and the Southern Appalachian Botanical Club: Washington Room, Mezzanine.</p> <p>8:00- 5:00 Registration and Information: Convention Lobby.</p> <p>8:00- 3:00 Registration for Trips: Convention Lobby.</p> <p>8:00- 5:00 Placement Service: Monroe Room, Mezzanine.</p> <p>Exhibits: Exhibition Hall.</p> <p>8:30- 1:00 Beta Beta Beta Paper Sessions and General Meeting: Byrd and Lee Rooms, Mezzanine.</p> <p>8:30-12:00 Paper Sessions:
<i>Ichthyology and Herpetology</i> — Marshall Room, Convention Lobby.
<i>Plant Ecology</i> — Dominion Room, Convention Lobby.
<i>Animal Ecology</i> — Colony Room, Convention Lobby.
<i>Plant Physiology</i> — Roof Garden, 14th Floor.
<i>Animal Physiology</i> — Jackson Room, Mezzanine.</p> | <p><i>Plant Taxonomy</i> — Washington Room, Mezzanine.
<i>Invertebrate Zoology and Parasitology</i> — Room 1452, 14th Floor.
<i>Cytology and Genetics</i> — Patrick Henry Room, Mezzanine.</p> <p>12:00- 1:00 Business Meeting, Association of Southeastern Biologists — Commonwealth Hall, Main Level.</p> <p>Noon Ladies Luncheon and Fashion Show — Miller & Rhoads 5th Floor Tea Room, Fifth and Grace Streets (½ block from the John Marshall).</p> <p>2:00- 5:00 Paper Sessions:
<i>Ichthyology and Herpetology</i> — Marshall Room, Convention Lobby.
<i>Plant Ecology</i> — Dominion Room, Convention Lobby.
<i>Animal Ecology</i> — Colony Room, Convention Lobby.
<i>Plant Physiology</i> — Roof Garden, 14th Floor.
<i>Animal Physiology</i> — Jackson Room, Mezzanine.</p> |
|--|--|

- Plant Taxonomy and Morphology* – Washington Room, Mezzanine.
Cryptogamic Botany – Room 1452, 14th Floor.
Developmental Biology and Anatomy – Patrick Henry Room, Mezzanine.
- 2:00- 5:00 Symposium: Restoration and Recovery of Damaged Ecosystems – Commonwealth Hall, Main Level.
- 7:00 P.M. A.S.B. Banquet and Presentation of Awards: Virginia Room, Convention Lobby. Association Research Prize. Sponsored by Carolina Biological Supply Company.

- Meritorious Teaching Award. Sponsored by The Association of Southeastern Biologists.
- Drawing for Free Weekend for Two in Colonial Williamsburg.
- 8:30 P.M. Address: Dr. Robert R. Curry, University of Montana – *Soil Destruction Associated with Forest Management and Other Uses, and Prospects for Recovery in Geologic Time.*
- 9:30 P.M. Social: Colony and Dominion Rooms, Convention Lobby. Sponsored by Scientific Products.

SATURDAY, APRIL 17

- Field Trips: Please register by 3:00 P.M. Friday, April 16, Convention Lobby. Buses will leave from the Fifth Street Entrance of the John Marshall.
- 8:00- 6:30 Calvert Cliffs Nuclear Power Plant and the Benedict Estuarine Laboratory of the Academy of Natural Sciences of Philadelphia. Leader: Mr. Dick Mulford of the Benedict Lab. Greyhound bus compliments of the Baltimore Gas and Electric Company. Cost: \$1.50 (for box lunch).
- 8:00- 5:00 Dismal Swamp and Seashore State Park. Leaders: Dr. Jack Brooks, College of William and Mary, and Dr. A. M. Harvill, Longwood College. Professional Forester guide provided by Union Camp Corporation. Cost: \$3.00 plus lunch.

- 8:00- 5:00 Colonial Williamsburg and the Pottery Shop. Includes transportation by bus, admission and guided tours of the Colonial buildings, and a stop at the Williamsburg Pottery Shop with its acres of bargains. Cost: \$5.00 plus lunch.
- 8:00-Noon Historic Richmond and the University of Richmond. Leader: Mr. Randy Walker, Director, UR Public Relations. A tour of Richmond's historic and scenic sites and a tour of the suburban campus of the University of Richmond. Bus compliments of the University of Richmond.
- 8:30 A.M. Executive Committee Meeting, Association of Southeastern Biologists: Lee Room, Mezzanine.

SCHEDULE OF PAPER SESSIONS

FRIDAY MORNING - APRIL 16

ICHTHYOLOGY AND HERPETOLOGY

Marshall Room, Convention Lobby

Presiding: Dr. Neil H. Douglas, Northeastern Louisiana State College

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| 8:30 | 1. LANDRY, MARTHA M. AND ANNE L. LAUDERDALE (Mississippi State College for Women). Preliminary Identifications of the Normal Intestinal Bacteria Isolated from One Specimen of <i>Trionyx spiniferons asper</i> . | 8:56 | 3. ESTRIDGE, RONALD E. AND ROBERT H. MOUNT (Alexander City State Junior College and Auburn University). On the Taxonomic Status of <i>Sternothaerus depressus</i> (Reptilia, Testudinata, Kinosternidae). |
| 8:43 | 2. JACKSON, CRAWFORD G., JR., CHARLIE M. HOLCOMB, SKAIDRITE KLEINBERGS AND MARGUERITE M. JACKSON (San Diego State College and Mississippi State College for Women). Bioaccumulation of Radionuclides in Turtle Shells (Reptilia, Testudines). | 9:09 | 4. PODGORNÝ, GEORGE, M.D. (Forsyth Memorial Hospital). Poisonous Snakebite East of Mississippi. |
| | | 9:22 | 5. CHINNICI, JOSEPH P. AND MARY ANN ANGLEBERGER (Virginia Commonwealth University |

and University of Virginia). Variation in the Frequencies of the Striped and Un-striped Forms of the Salamander *Plethodon c. cinereus* (Urodela, Plethodontinae) on Potts and Salt Pond Mountain, Giles County, Virginia.

- 9:35 6. MEANS, D. BRUCE (Florida State University and Tall Timbers Research Station). Dental Morphology in Desmognathine Salamanders (Amphibia, Plethodontidae).
- 9:48 7. LITTLE, RICHARD B. (Auburn University). Diagnostic Characteristics for Distinguishing *Acris gryllus gryllus* and *Acris crepitans crepitans* (Amphibia, Anura, Hylidae).
- 10:01 8. SUTTON, BRUCE AND KENNETH RELYEA (Jacksonville University). Notes on the Georgia Blind Cave Salamander, *Haideotriton wallacei*.
- 10:14 9. OUTTEN, L. M. (Mars Hill College). Effects of Gradient on the Distribution of Fishes in Western North Carolina (Osteichthyes).
- 10:27 10. COURTENAY, WALTER R., JR. (Florida Atlantic University). Sexual Dimorphism of the Sound Producing Mechanism of the Striped Cusk Eel, *Rissola marginata* (Pisces, Ophidiidae).

- 10:40 11. MERRINER, JOHN V. (Virginia Institute of Marine Science). Life History Aspects of the Tripletail, *Lobotes surinamensis* (Chordata, Pisces, Lobotidae), in Temperate Waters.
- 10:53 12. LINK, GARNETT W., JR. AND WILLIAM S. WOOLCOTT (University of Richmond). Comparative Age and Growth in Two Species of *Percina* (Percidae) in Virginia (Osteichthyes, Perciformes, Percidae).
- 11:06 13. ETNIER, DAVID A. AND CHARLES E. COMISKEY (University of Tennessee). Derivation of the Fish Fauna of the Big South Fork of the Cumberland River.
- 11:19 14. ROSS, ROBERT D. AND MICHAEL T. MASNIK (Virginia Polytechnic Institute). A Report of Fishes Collected in the Clinch River.
- 11:32 15. WILLIAMS, JAMES D. AND JAMES L. WOLFE (Mississippi State College for Women and Mississippi State University). Fishes from the Blackwater River in Florida and Alabama with Zoogeographic Notes.
- 11:45 16. WILLIAMS, JAMES D. (Mississippi State College for Women). A New Percid Fish of the Genus *Ammocrypta* from Western Florida and Southeastern Alabama.

PLANT ECOLOGY

Dominion Room, Convention Lobby

Presiding: Dr. Howard Teas, University of Miami

- 8:30 17. MOORE, JAMES K. (University of North Carolina). Relict Cranberry Glades in North Carolina.
- 8:43 18. LANZA, GUY R. AND JOHN CAIRNS, JR. (Virginia Polytechnic Institute and State University). Certain Effects of Sudden Temperature Increases upon Diatom Populations.
- 8:56 19. ANDORFER, HOWARD AND HOWARD TEAS (University of South Florida and University of Miami). Seed Germination Inhibition by Leaf Extracts of *Swietenia mahogani* Jacq. (Meliaceae).
- 9:09 20. MCCORMICK, J. FRANK, JOHN R. BOZEMAN AND STEPHEN SPONGBERG (University of North Carolina, Georgia Southern College and Harvard University). A Taxonomic Revision of Granite Outcrop Species of *Are-naria* (*Minuartia*).
- 9:22 21. HARRIS, W. F. (Oak Ridge National Laboratory). The Effects of Acute Fast Neutron Radiation on Factors Influencing Drought-Susceptibility of Yellow Poplar (*Liriodendron tulipifera* L.) Seedlings.
- 9:35 22. EDMISTEN, JOE A. (The University of West Florida). The Nitrogen Budget of a Tropical Rain Forest.
- 9:48 23. STALTER, RICHARD (Brookgreen Gardens, S. C.). The Vegetation of Northern New England Salt Marshes.
- 10:01 24. KRAFT, JAMES D. AND EDWARD E. GILBERT (West Georgia College). Trees as Pollution Indicators, I. Loblolly and Aqueous Wastes.
- 10:14 25. BASKIN, JERRY M. AND CAROL C. BASKIN (University of Kentucky). The Possible Ecological Significance of the Light-Requirement for Germination in *Cyperus inflexus*.
- 10:27 26. BASKIN, CAROL C. AND JERRY M. BASKIN (University of Kentucky). Germination of Winter Annuals in July and Survival of the Seedlings.
- 10:40 27. NEMETH, JOHN CHARLES (North Carolina State University). Dry-matter Production in Young Loblolly (*Pinus taeda*) and Slash (*Pinus elliotii*) Pine Plantations: Estimation of Root Biomass (Gymnospermae, Coniferales, Pinaceae).
- 10:53 28. CREIGHTON, SHARON J. AND JOE A. EDMISTEN (The University of West Florida). Mesic Hardwood Hammock Nature Trail.

- 11:06 29. OBENG-ASAMOA, E. K. AND B. C. PARKER (Virginia Polytechnic Institute and State University). A Limnological Survey of Mountain Lake, Giles County, Virginia.
- 11:19 30. RITCHIE, JERRY C., CAROLE A. RITCHIE AND GAYTHER L. PLUMMER (U. S. Sedimentation Laboratory and University of Georgia). Soil Moisture Characteristics of Different Ecosystems on the Little River Watershed, Georgia.
- 11:32 31. WHIGHAM, DENNIS (University of North Carolina). The Ecological Life History of *Uvularia perfoliata* L. (Angiospermae, Liliaceae).
- 11:45 32. SAMSEL, G. L., B. C. PARKER AND E. B. WODEHOUSE (Virginia Polytechnic Institute and State University). Ammonia as a Significant Nitrogen Source for Antarctic Freshwater Ecosystems. I. Uptake and Effects.
- 11:58 33. WODEHOUSE, E. B., B. C. PARKER AND C. L. SAMSEL (Virginia Polytechnic Institute and State University). Ammonia as a Significant Nitrogen Source for Antarctic Freshwater Ecosystems. II. Origin and Transport.

ANIMAL ECOLOGY

Colony Room, Convention Lobby

Presiding: Dr. George Simmons, Virginia Commonwealth University

- 8:30 34. REYNOLDS, JOHN W. (The University of Tennessee). The Effects of Altitude, Soil Moisture and Soil Acidity on Earthworms (Oligochaeta: Acanthodrilidae and Lumbricidae) Density, Biomass and Species Diversification in *Liriodendron tulipifera* L. Stands in Two Areas of East Tennessee.
- 8:43 35. YONGUE, WILLIAM H., JR. AND JOHN CAIRNS, JR. (Virginia Polytechnic Institute and State University). Colonization and Persistence of Fresh-Water Protozoans in Artificial Substrates Suspended in a Small Pond in North Carolina.
- 8:56 36. BENFIELD, ERNEST F., KENNETH L. DICKSON, DAVID P. KLARBERG AND JOHN CAIRNS, JR. (Virginia Polytechnic Institute and State University). Pre-Impoundment Water Quality Survey on the New River: A Preliminary Report.
- 9:09 37. HENDRICKS, ALBERT C. (Virginia Polytechnic Institute and State University). An Investigation of the Various Areas of a Reservoir for the Purpose of Determining if Different Eutrophic Levels Occurred Among Them.
- 9:22 38. MORGAN, ERIC L., DENNIS T. BURTON AND JOHN CAIRNS, JR. (Virginia Polytechnic Institute and State University). A Time Until Death Study of Bluegill Sunfish (*Lepomis macrochirus* Raf.) Exposed to Simultaneous Thermal and Zinc Stress.
- 9:35 39. COLE, TIMOTHY J. AND CHARLES A. GIFFORD (The University of West Florida). Rain Forest Decapod Crustaceans: I. A Systematic Survey.
- 9:48 40. GIFFORD, CHARLES A. AND TIMOTHY J. COLE (The University of West Florida). Rain Forest Decapod Crustaceans: II. Osmotic and Ionic Regulation.
- 10:01 41. LORTON, GENE (Virginia Polytechnic Institute and State University). Preliminary Studies of the Effects of Simulated Heated Discharges from Power Generating Stations on Protozoan Communities.
- 10:14 42. COOPER, JOHN E. AND MARTHA R. COOPER (Community College of Baltimore and National Speleological Society). Studies of the Aquatic Ecology of Shelta Cave, Huntsville, Alabama.
- 10:27 43. FORE, PAUL L. (National Marine Fisheries Service). The Distribution of the Eggs and Larvae of the Round Herring, *Etrumeus teres*, in the Northern Gulf of Mexico.
- 10:40 44. RUTHVEN, JEANNE A. AND JOHN CAIRNS, JR. (Virginia Polytechnic Institute and State University). The Distribution of Fresh-Water Protozoans on Abaco Island, Bahamas.
- 10:53 45. PETERS, DAVID S. (National Marine Fisheries Service and North Carolina State University). Planktonic Copepod (Crustacea: Harpacticoida) Distribution and Regulating Factors in the Pamlico River Estuary.
- 11:06 46. BARR, THOMAS C., JR. (University of Kentucky). Forest Floor Populations of Carabid Beetles (Coleoptera: Carabidae) on the Blue Ridge Escarpment in North Carolina.
- 11:19 47. MCBRAYER, J. F. (Oak Ridge National Laboratory). Radiotracer Analysis of Feeding by Soil Invertebrates.
- 11:32 48. THAYER, GORDON W. AND MICHAEL W. LA-CROIX (National Marine Fisheries Service). Standing Crop, Biomass, and Respiration of the Epibenthic Invertebrate Community of an Eelgrass Bed.
- 11:45 49. DAHLBERG, MICHAEL D. (Virginia Institute for Scientific Research). Indices of Fish Species Diversity as Pollution Indicators.
- 11:58 50. DAVIS, J. S. (University of Florida). The Plant and Animal Associations of the Diamond Crystal Salt Ponds.

PLANT PHYSIOLOGY

Roof Garden, 14th Floor

Presiding: Dr. William H. Queen, University of South Carolina

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| <p>9:09 51. MOHANTY, MAHENDRA K. AND FRISSELL R. HUNTER (Atlanta University). NADH and NADPH Diaphorases in <i>Euglena gracilis</i> var. <i>bacillaris</i>.</p> <p>9:22 52. SEHGAL, PREM P., CLAUDE L. HUGHES, BRENDA E. PUGH AND THOMAS M. VICARS (East Carolina University). Chlorophyll Production and Retention in Mustard Seedlings.</p> <p>9:35 53. WILLIAMS, LOUIS G. (University of Alabama). Effect of Calcium on Live and Dead Uptake of ^{85}Sr and ^{137}Cs by <i>Cladophora</i> and <i>Pithophora</i>.</p> <p>9:48 54. WOLF, FREDERICK T. (Vanderbilt University). The Development of Photosynthetic Capacity by Etiolated Seedlings upon Illumination.</p> <p>10:01 55. PIKE, JOHN D. (Georgia Southern College). Environmental Effects on the Pigmentation of the Blue-green Alga, <i>Chlorogloea fritschii</i>.</p> <p>10:14 56. SCOTT, T. K. AND MRIDUL BATRA (University of North Carolina). The Transport of Auxin in the Primary Root of <i>Zea mays</i> (Monocotyledonae, Poales, Poaceae).</p> | <p>10:27 57. THOMAS, JERRY P., SAMUEL W. MOSS AND JOSEPH C. O'KELLEY (University of Alabama). Sr Substitution for Ca and Algal Cell Size.</p> <p>10:40 58. WYATT, J. T. (East Tennessee State University). Some Effects of Different Atmospheres on Chroococcean Blue-Green Algal Acetylene Reduction.</p> <p>10:53 59. BAKER, GAIL SYDNEY (Mississippi State University). The Effects of Stratification, Light and Temperature on the Germination of Sweetgum (<i>Liquidambar styraciflua</i>) Seeds (Angiospermae, Rosales, Hamamelidaceae).</p> <p>11:06 60. HILLIARD, JOE H. AND S. H. WEST (University of Florida and USDA, ARS). Photorespiration and the Occurrence of Leaf Microbodies and Chloroplast Peripheral Reticulum in Grasses Differing in Their CO_2 Fixation Pathways.</p> <p>11:19 61. DARDEN, WILLIAM H., JR. (University of Alabama). The Control of Male Differentiation in <i>Volvox aureus</i> M5 (Chlorophyceae, Volvocales, Volvocaceae).</p> |
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ANIMAL PHYSIOLOGY

Jackson Room, Mezzanine

Presiding: Dr. Gerald C. Llewellyn, Virginia Commonwealth University

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| <p>8:30 62. MACGREGOR, ROBERT, III AND ALBERT H. MEIER (Louisiana State University). Daily Variations of the Oviducal Responses in the House Sparrow, <i>Passer domesticus</i>.</p> <p>8:43 63. KIMBROUGH, T. DANIEL, RICHARD A. GRENOBLE AND GERALD C. LLEWELLYN (Virginia Commonwealth University). A Baseline Hematological Determination of Blood Platelets, Leukocytes and Oxyhemoglobin Levels in the Meadow Vole (<i>Microtus pennsylvanicus</i>).</p> <p>8:56 64. VAN HOOK, ROBERT I., JR. AND E. T. HERBERT (Oak Ridge National Laboratory and Randolph Macon Woman's College). Effects of Gamma Radiation and Temperature on the Biological Assimilation and Retention of ^{137}Cs by <i>Acheta domesticus</i> (L.).</p> <p>9:09 65. MOFFETT, GLADYS AND JAMES D. YARBROUGH (Mississippi State University). The Effect of DDT and Dieldrin on Succinic Dehydrogenase Activity in <i>Gambusia affinis</i>.</p> <p>9:22 66. WELLS, MARION R. AND JAMES D. YARBROUGH (Mississippi State University). The</p> | <p><i>in vitro</i> Endrin Effect on Succinic Dehydrogenase Activity in Endrin-Resistant and Susceptible Mosquitofish (<i>Gambusia affinis</i>).</p> <p>9:35 67. FRANDSEN, JOHN C. AND JUDITH A. COOPER (USDA Regional Parasite Research Laboratory). Some Properties of L-lactate Dehydrogenase from <i>Eimeria stiedae</i> (Protozoa, Coccidia). II. Further Studies of the Semi-purified Enzyme.</p> <p>9:48 68. HOGAN, G. R. AND A. E. CODY (University of North Carolina). Effects of Androgen Treatment on Peripheral Blood.</p> <p>10:01 69. SPARKS, RICHARD E., GLENN SUTER, II, ROGER A. McNABB AND JOHN CAIRNS, JR. (Virginia Polytechnic Institute and State University). Coughing and Other Respiratory Symptoms in Bluegills (<i>Lepomis macrochirus</i> Rafinesque) Exposed to Lethal and Sublethal Concentrations of Zinc.</p> <p>10:14 70. HETTLER, W. F., JR. AND D. E. ROSS (National Marine Fisheries Service). A Comparison of Two Flowing Respirometers for Measuring Fish Oxygen Consumption.</p> |
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- 10:27 71. MEIER, ALBERT H. AND DONN D. MARTIN (Louisiana State University). Circadian Basis of the Hormonal Control of Fattening in the White-throated Sparrow, *Zonotrichia albicollis*. Control of the Fattening Response to Prolactin in *Fundulus grandis*.
- 11:06 74. SMILEY, JAMES W. (Northeast Louisiana University). Induction of Gastrolith Formation in Crayfish by Exogenous Ecdysterone.
- 10:40 72. WARNER, CYNTHIA K. (Emory University). Observations on the Neurosecretory Cells of *Lehmanna poireiri* (Mabille) Under Osmotic Stress.
- 11:19 75. TROBEC, TERRY N. AND ALBERT H. MEIER (Louisiana State University). Temporal Synergism of Prolactin and Corticosterone in the Regulation of Fat Stores in the Lizard, *Anolis carolinensis*.
- 10:53 73. JOSEPH, M. M. AND ALBERT H. MEIER (Louisiana State University). Photoperiodic

PLANT TAXONOMY

Washington Room, Mezzanine

Presiding: Dr. John D. Reynolds, Virginia Commonwealth University

- 9:35 76. SHARP, A. J. (The University of Tennessee). An Unreported Structure in the Mosses: Multicellular Chlorophyllose Filaments on the Setae of a Moss in the Hookeriaceae.
- 10:40 81. JOHNSON, MILES F. (Virginia Commonwealth University). Distribution of *Liatrix*, *Mikania*, *Kuhnia* and *Carphephorus* (Eupatoriaceae, Compositae) in Virginia.
- 9:48 77. STEWART, SHELTON E. (Lander College). Breaking Male Sterility in *Impatiens sultani* Hook. f. by Hybridization (Malvales, Balsaminaceae).
- 10:53 82. ODENWELDER, JERRY C. (University of Tennessee). Chemosystematic Studies of Sporophytes of Native *Lycopodium* Utilizing Polyacrylamide Gel Electrophoresis.
- 10:01 78. BELL, C. RITCHIE (University of North Carolina). Trends to Specialized Pollination in the Apiaceae.
- 11:06 83. BARANSKI, MICHAEL J. (North Carolina State University). Distributional Analysis of *Quercus alba* L. (Fagaceae) in Southern Appalachians.
- 10:14 79. DRAPALIK, DONALD J. (Georgia Southern College). The Effect of Four Herbarium-drying Methods on Corolla Lobe Shrinkage in *Matelea* (Asclepiadaceae).
- 11:19 84. RADFORD, ALBERT E. (University of North Carolina). Flora—Objectives and Analysis.
- 10:27 80. MEIJER, WILLEM (University of Kentucky). The Contribution of Rafinesque to the Early Botanical Exploration of Kentucky.
- 11:32 85. WATSON, J. RAY (Mississippi State University). Oleaceae of Mississippi.

INVERTEBRATE ZOOLOGY AND PARASITOLOGY

Room 1452, 14th Floor

Presiding: Dr. Jesse C. Thompson, Jr., Roanoke College

- 8:30 86. FLEMING, LAURENCE E. (Virginia Polytechnic Institute). The Generic Status of the Eastern North American Isopods of the Family Asellidae.
- 9:09 89. HARRISON, FREDERICK W. (Presbyterian College). The Stylocyte: A New Poriferan Cell Type.
- 8:43 87. COSTES, DANICE H. (Troy State University). Comparative Morphological Study of Five Tribes of Cercopinae (Insecta, Homoptera, Cercopidae).
- 9:22 90. SAWYER, ROY T. (College of Charleston). The Rediscovery of the Biannulate Leech, *Oligobdella biannulata* (Moore 1900), in Mountain Streams of South Carolina (Annelida, Hirudinea).
- 8:56 88. FERGUSON, LYNN M. (Virginia Polytechnic Institute and State University). Report on the Taxonomy and Distribution of Cavernicolous Bristletails (Insecta, Diplura, Camptopodeidae) in Virginia.
- 9:35 91. FOSTER, NEAL R. (Academy of Natural Sciences of Philadelphia). *Valentinia gabriellae* (Hydromedusae, Trachymedusae, Olinidiadidae), an Easily-cultured Jellyfish.

- 9:48 92. ABEL, DAVID G. (Western Kentucky University). The Vertical Distribution and Seasonal Occurrence of Rotifera in the Main Pool of a Kentucky Reservoir.
- 10:01 93. THOMPSON, JESSE C., JR. (Roanoke College). Antarctic Ciliated Protozoa.
- 10:14 94. OLEWINE, DONALD A. AND RANDALL L. MORTON (Georgia Southern College). Observations on the Collection and Maintenance in the Laboratory of the Land Planarian, *Bipalium kewense*.
- 10:27 95. JOHNSON, CHARLES A. AND REINARD HARKEMA (North Carolina State University). The Life History of *Pomphorhynchus rocci* Cordonnier and Ward, 1967 (Acanthocephala) in the Striped Bass, *Morone saxatilis*.
- 10:40 96. MILLER, GROVER C. AND REINARD HARKEMA (North Carolina State University). The Life Cycle of *Pharyngostomoides procyonis* (Trematoda, Strigeoidea). Studies on the Second Intermediate Host.
- 10:53 97. SARGENT, ROGER G. AND FELIX H. LAUTER (University of South Carolina). A Study of Variations in Embryonation Time for the Ova of *Ascaris lumbricoides* (Linnaeus, 1758).
- 11:06 98. STUART, JEANNE J., JOHN F. DISMUKES AND CARL F. DIXON (Auburn University). Further Studies of Some Gastrointestinal Helminth Parasites of the Cattle Egret, *Bubulcus ibis* (Aves, Ciconiiformes, Ardeidae).
- 11:19 99. MECHAM, JOHN A. AND R. B. HOLLIMAN (Virginia Polytechnic Institute and State University). Acute Zinc Toxicity to *Schistosoma mansoni* (Trematoda, Strigeatoidea, Schistosomatidae) Cercariae in a Chemically Defined Water Medium.
- 11:32 100. BARRAS, DONALD J., R. L. JOINER AND S. B. VINSON (Troy State University). Neutral Lipid Composition of the Tobacco Budworm, *Heliothis virescens* (Fab.), as Affected by Its Habitual Parasite, *Cardiochiles nigriceps* Viereck.
- 11:45 101. SARGENT, ROGER G. AND FELIX H. LAUTER (University of South Carolina). A Study of Variations in Embryonation Time for the Ova of *Trichuris trichiura* (Linnaeus, 1771) Stiles 1901.

CYTOLOGY AND GENETICS

Patrick Henry Room, Mezzanine

Presiding: Dr. Thomas M. Harris, Medical College of Virginia

- 8:30 102. ALDRICH, HENRY C. (University of Florida). Three Dimensional Ultrastructure of Myxomycetes as Viewed by Freeze-etching.
- 8:43 103. STALLARD, RICHARD (Emory University). Nucleic Acid Precursors and Chromosome Aberrations in *Tradescantia paludosa* Microspores Irradiated in Air.
- 8:56 104. MCCracken, KATHERINE M. AND CHARLES W. FOREMAN (University of South Carolina and University of the South). A New Hemoglobin Variant in the Deermouse (*Peromyscus maniculatus* — Mammalia, Rodentia, Cricetidae).
- 9:09 105. WELCH, ROBERT M. (West Georgia College). DNA and Protein Synthesis in the Liver of the Heterozygous Grey-lethal Mouse (*Mus musculus*) (Mammalia, Rodentia, Muridae).
- 9:22 106. ROOS, URS-PETER AND HENRY C. ALDRICH (University of Florida). Light and Electron Microscopy of Mitotic Aberrations in a Mammalian Cell *in vitro*.
- 9:35 107. ST. AMAND, W. (University of Mississippi). Homogeneity of Sex Difference in Recombination Frequency in Linkage Group IV of the Mouse.
- 9:48 108. BROWN, PAT I. AND JAN MARTAN (Southern Illinois University). Polarized Cylindrical Bodies in the Epididymis of *Tamias striatus* (Mammalia, Rodentia, Scuridae).
- 10:01 109. JACKSON, H. G. AND PRISCILLA S. RUSHTON (Memphis State University). The Relationship of Intracellular Energy Levels to Crossing-over in *Neurospora crassa*.
- 10:14 110. HAYSMAN, PHILIP AND H. BRANCH HOWE, JR. (University of Georgia). Some Genetic and Physiological Characteristics of Urease-defective Strains of *Neurospora crassa*.
- 10:27 111. TOWNSEND, J. IVES, RAGNIT GEERAETS AND RICHARD A. BANKS (Medical College of Virginia, Virginia Commonwealth University). Insemination Frequencies in *Drosophila equinoxialis*.
- 10:40 112. FATTIG, W. DONALD AND WAYNE L. RICKOLL (University of Alabama). Isolation of Recessive Temperature-Sensitive Mutants on the Third Chromosome of *Drosophila melanogaster*.
- 10:53 113. MULLINS, DAH W., JR. AND W. DONALD FATTIG (University of Alabama). Isolation of Recessive Temperature-Sensitive Mutants on the First Chromosome (X) of *Drosophila melanogaster*.
- 11:06 114. WRIGHT, C. PAUL (Western Carolina University). Attempts to Delay Death in Some Lethal Mutants of *Drosophila melanogaster*.

FRIDAY AFTERNOON - APRIL 16

ICHTHYOLOGY AND HERPETOLOGY

Marshall Room, Convention Lobby

Presiding: Dr. Crawford G. Jackson, Jr., San Diego State College

- 2:00 115. HARIMA, HECTOR AND PHILIP R. MUNDY (University of Alabama). Abundance and Diversity of Fish Populations in a Small Stream.
- 2:13 116. STILES, ROBERT A. AND JERRY F. HOWELL (University of Tennessee). Observations on Winter Habitats of Various Darters (*Etheostoma* and *Percina*) in Tennessee's Little River.
- 2:26 117. REED, JAMES R. (Virginia Commonwealth University). The Effects of Acid Mine Pollution on the Fish Population of the North Anna River, Virginia.
- 2:39 118. METTEE, MAURICE F., JR. (University of Alabama). A Survey of the Fishes of the Choctawatchee Bay Drainage in Alabama and Florida.
- 2:52 119. RELYEA, KENNETH AND JULIAN HUMPHRIES (Jacksonville University). Preliminary Report on Geographic Variation and Distribution of *Floridichthys cerpio* (Pisces, Atheriniformes, Cyprinodontidae), with Comments on Southeastern Killifish Distribution.
- 3:05 120. JONES, THOMAS E. AND JOHN D. PIKE (Knoxville College). Comparative Growth of Paradise-fish Fry on Three Diets (Teleostomi, Perciformes, Anabantidae).
- 3:18 121. FRUGE, DAVID W. (Northeast Louisiana University). Fishes of the Caddo River, West-central Arkansas.
- 3:31 122. REYNOLDS, JAMES T. (Northeast Louisiana University). Fishes of the Saline River, South-central Arkansas.
- 3:44 123. BORTONE, STEPHEN A. (Institute of Marine Sciences and University of North Carolina). Ontogenetic and Behavioral Color Patterns in the Sand Perch, *Diplectrum formosum* (Pisces, Serranidae).
- 3:57 124. JENKINS, ROBERT E. (Roanoke College). Behavioral and Morphological Evidence of Monophyly of Nest-building Cyprinid Fishes.
- 4:10 125. DOOLEY, JAMES K. (University of North Carolina). Fishes Associated with Pelagic Sargassum in the Florida Current.
- 4:23 126. COOPER, JOHN E. (Community College of Baltimore and National Speleological Society). Interesting New Locality Records for the Southern Cavefish, *Typhlichthys subterraneus* Girard (Pisces, Amblyopsidae).
- 4:36 Business Meeting, Southeastern Section, American Society of Ichthyologists and Herpetologists.

PLANT ECOLOGY

Dominion Room, Convention Lobby

Presiding: Dr. J. Frank McCormick, University of North Carolina

- 2:00 127. SHARITZ, REBECCA R. (Saginaw Valley College). Population Dynamics of Two Plant Species in Granite Outcrop Communities.
- 2:13 128. BURK, C. JOHN (Smith College). Ecological Studies of Marsh Vegetation Along a Short, Highly Disturbed River Ecosystem.
- 2:26 129. WASS, MARVIN L. (Virginia Institute of Marine Science). Standing Crop Estimates of Several Dominant Marsh Plants in Virginia.
- 2:39 130. ROPER, ELIZABETH W. AND H. R. DESELM (University of Tennessee). Prediction of Tree Growth from Old Field Vegetation.
- 2:52 131. GOLDEN, MICHAEL S. AND H. R. DESELM (The University of Tennessee). Vegetation and Site Relationships in the Mt. LeConte-Greenbrier Cove Area of the Great Smoky Mountains National Park.

- 3:05 132. PEDIGO, ROBERT A. (St. Andrews Presbyterian College). Effects of DMSO and Fertilizer on the Growth of *Zea mays* and *Nicotiana tabacum*.
- 3:18 133. WITHERSPOON, JOHN P. AND MARGARET E. HERBERT (Oak Ridge National Laboratory). Transfers of Cesium-134 from a Tree Canopy to Understory Vegetation.
- 3:31 134. WAGGONER, GARY S. (North Carolina State University). A Call for Suggestions of Natural Areas in the Oak-Pine and Southeastern Evergreen Forest Regions of the Southeast.
- 3:44 135. KRUMPE, P. F., H. R. DESELM AND C. C. AMUNDSEN (The University of Tennessee). The Delineation and Prediction of Forest Cover and Site Parameters by Multiband Remote Sensing.
- 3:57 136. RADFORD, JOHN STEWART (University of North Carolina). Correlation of Altitude and Heat Accumulation with Progression of Flowering of Two Common Understory Tree Species Across North Carolina.
- 4:10 137. PITTILO, J. DAN AND J. H. HORTON (Western Carolina University). Vegetation of Southern Highland Rock Outcrops.
- 4:23 138. TAYLOR, FRED G. AND JOHN P. WITHERSPOON (Oak Ridge National Laboratory). Retention of 1-44 μ Simulated Fallout Particles by Soybean and Sorghum Plants.
- 4:49 139. STROUD, LINDA M. AND A. W. COOPER (North Carolina State University). Prediction of Stem Weight from Height and Diameter in *Spartina alterniflora*.

ANIMAL ECOLOGY

Colony Room, Convention Lobby

Presiding: Dr. Charles Blem, Virginia Commonwealth University

- 2:00 140. SCHMOLLER, RONALD R. (The University of Tennessee). Night Life High in the Colorado Rockies.
- 2:13 141. PRICE, T. J., G. W. THAYER AND M. W. LA-CROIX (National Marine Fisheries Service). The Organic Content of Shells, Tissues, and Extrapallial Fluid of Some Estuarine Pelecypods and Its Ecological Implications.
- 2:26 142. LABAN, CORNELIS (Richard Bland College). A Simulated Natural Habitat for Raccoons (*Procyon lotor*).
- 2:39 143. GILBERT, EDWARD E. (West Georgia College). Tunnelling of *Tribolium* Instars, a Photographic Study.
- 2:52 144. BAMFORTH, STUART S. (Newcomb College of Tulane University). Protozoan Succession in Autumn Leaves.
- 3:05 145. THOMAS, M. H. AND G. M. SIMMONS, JR. (Virginia Water Control Board and Virginia Commonwealth University). Community Structure of the Macrobenthos in Four Tributaries in the Pre-impoundment Basin of the North Anna River, Virginia.
- 3:18 146. SIMMONS, GEORGE M., JR. AND AVIS WINFIELD (Virginia Commonwealth University). A Feasibility Study Using Conservation Webbing as an Artificial Substrate.
- 3:31 147. BOHANNON, BETTY JO AND JOE A. EDMISTEN (University of West Florida). Nitrogen Fixation in Escambia Bay.
- 3:44 148. PARRISH, FRED K. (Georgia State University). Limnological Studies of the Okefenokee Swamp.
- 3:57 149. ADAMS, SANDRA AND FRED K. PARRISH (Georgia State University). Preliminary Report of Primary Productivity in the Okefenokee Swamp.
- 4:10 150. TAYLOR, BERYLL AND FRED K. PARRISH (Georgia State University). Destruction of Gametes and Early Cleavage Stages of *Crassostrea virginica* by Mild Heat Shock.
- 4:23 151. BENFIELD, ERNEST F. (Virginia Polytechnic Institute and State University). A Laboratory Investigation on the Function of the External Secretion of the Whirligig Beetle, *Dineutus discolor* (Coleoptera: Gyrinidae).
- 4:36 152. BUNTING, DEWEY L. (University of Tennessee). Species Composition and Distribution of Zooplankton in Reservoirs.
- 4:49 153. FINLEY, MACK T., J. LARRY LUDKE AND CHRISTINA LUSK (Mississippi State University). Toxicity of Mirex to Several Crustaceans.
- 5:02 154. DAME, RICHARD F. (University of South Carolina). Mathematical Models for Growth in Intertidal Oysters, *Crassostrea virginica* (Bivalvia, Anisomyaria, Ostreaeidae).

PLANT PHYSIOLOGY

Roof Garden, 14th Floor

Presiding: Dr. B. P. Stone, Austin Peay State University

- 2:00 155. BROWN, SAMUEL D. AND WILLIAM H. QUEEN (University of South Carolina). Root Inundation as a Factor Affecting the Vertical Position of *Spartina alterniflora* in Coastal Marshes.
- 2:13 156. QUEEN, WILLIAM H. (University of South Carolina). Variations in Nitrogen Content with Plant Elevation in the Marsh Grass, *Spartina alterniflora*.
- 2:26 157. LEE, JULIE AND WILLIAM H. QUEEN (University of South Carolina). Malic Acid Dehydrogenase Activity in *Spartina alterniflora* (Angiospermae, Graminales, Gramineae).
- 2:39 158. LUCE, PAUL T. AND WILLIAM H. QUEEN (University of South Carolina). Salinity as a Plant Distribution Effector: Photosynthesis and Respiration in *Spartina alterniflora*.
- 2:52 159. TUCKER, ROBERT G. AND WILLIAM H. DARDEN, JR. (University of Alabama). Nucleic Acid Synthesis and Development in *Volvox aureus* M5.
- 3:05 160. ELY, THOMAS H. AND WILLIAM H. DARDEN, JR. (Longwood College and University of Alabama). Purification of the Male Inducing Substance of *Volvox aureus* M5 and Estimation of Its Molecular Weight.
- 3:18 161. THOMAS, DEMPSEY L. AND N. J. NEUCERE (U.S. Dept. of Agriculture, New Orleans, La.). Isoperoxidases of Germinating Peanuts (*Arachis hypogaea* L.).
- 3:31 162. MORRISON, RALPH M. (University of North Carolina). Physical Factors in Conidial Germination of *Erysiphe cichoracearum*.
- 3:44 163. WALLACE, JAMES W. (Western Carolina University). Aspects of the Phenolic Acid Distribution in the Cycadaceae.
- 3:57 164. MILLS, MELINDA B. AND B. P. STONE (Austin Peay State University). Induction of a Light Requirement for Germination in *Lactuca sativa* Lettuce Seeds.
- 4:10 165. HARKER, META S., T. W. MERRELL AND B. P. STONE (Austin Peay State University). Ethionine Reversal of Gibberellic Acid Stimulation of Hypocotyl Elongation in *Lactuca sativa* var. Grand Rapids.

ANIMAL PHYSIOLOGY

Jackson Room, Mezzanine

Presiding: Dr. Roger McNabb, Virginia Polytechnic Institute and State University

- 2:00 166. MECHAM, JOHN A. AND ROGER McNABB (Virginia Polytechnic Institute and State University). The Effects of Temperature on the Rate of Gas Secretion and the Composition of Gases in the Swimbladder of the Bluegill Sunfish, *Lepomis macrochirus* (Osteichthyes, Perciformes, Centrarchidae).
- 2:13 167. LLEWELLYN, GERALD C. AND ALICE E. PYLES (Virginia Commonwealth University). Differential Growth Rates in Experimental Meadow Voles.
- 2:26 168. BURTON, DENNIS T., ALMA H. JONES AND JOHN CAIRNS, JR. (Virginia Polytechnic Institute and State University). A Preliminary Study Which Supports the Mucous Coagulation-Suffocation Hypothesis in Fish Exposed to Acutely Toxic Concentrations of Zinc.
- 2:39 169. STOUFFER, RICHARD L., ROGER A. McNABB AND F. M. ANNE McNABB (Virginia Polytechnic Institute and State University). Development of Thermoregulatory Ability and the Thyroid Gland in Embryonic Japanese Quail, *Coturnix c. japonica* (Aves, Galliformes).
- 2:52 170. COLEMAN, MARILYN AND ALAN C. HEATH (Virginia Polytechnic Institute and State University). Toxicity of $ZnSO_4$ to the Crayfish *Cambarus bartonii*.
- 3:05 171. LLEWELLYN, GERALD C. AND MARGARET G. TRENCHARD (Virginia Commonwealth University). The Toxicological Response of *Dugesia tigrina* to Aflatoxin B₁.
- 3:18 172. HOUSE, H. W. AND D. L. CLAYBROOK (University of South Carolina). Purification and Properties of Bovine Brain Arylamidase.
- 3:31 173. KIMBROUGH, T. DANIEL (Virginia Commonwealth University). A Correlation and Evaluation of Serotonin Kinetics in the Pineal Organ and Intestine of the Rat.
- 3:44 174. LUDKE, J. LARRY AND JAMES R. GIBSON (Mississippi State University). *In vivo* Activity of Mixed Function Oxidases (MFO) in Freshwater Fishes.
- 3:57 175. GIBSON, JAMES R. AND J. LARRY LUDKE (Mississippi State University). Comparative Biochemistry of Parathion Activation in Two (2) Species of Fishes.

- 4:10 176. DAVIS, KENNETH B. AND KENNETH DICKSON (Memphis State University and University of Tennessee). Long Term Effects of Blinding, or Blinding and Pinelectomy and Thyroxin on Locomotor Activity Patterns, Water Consumption and Organ Weights in the Rat

(Mammalia, Rodentia).

- 4:23 177. MOSELEY, ANDREW W. (Memphis State University). Normal Blood Glucose and Liver Glycogen Levels in C3H and Dublin ICR Mice.

PLANT TAXONOMY AND MORPHOLOGY

Washington Room, Mezzanine

Presiding: Dr. Miles Johnson, Virginia Commonwealth University

- 2:00 178. FAIRCLOTH, WAYNE R. (Valdosta State College). Vascular Flora of Central South Georgia.
- 2:13 179. COFFEY, JANICE C. (Queens College). Comparative Studies Within Two Species of *Luzula* DC. (Angiospermae, Juncaceae).
- 2:26 180. KING, BRUCE L. (University of Georgia). The Systematics of *Vernonia lindheimeri*.
- 2:39 181. JONES, SAMUEL B. (University of Georgia). Systematic Studies in the Fasciculatae Species Group of *Vernonia* (Compositae).
- 2:52 182. FAUST, W. ZACK (University of Georgia). A Biosystematic Study of the Species-group Interiores of *Vernonia* (Compositae).
- 3:05 183. REYNOLDS, JOHN D. AND WILLIAM V. DASHEK (Virginia Commonwealth University). A Cytochemical Analysis of Callose Distribution in *Lilium longiflorum* (Monocotyledoneae) Pollen Tubes.
- 3:18 184. SMITH, BRUCE B. AND J. M. HERR, JR. (University of South Carolina). A Study of Some Embryological Features of *Cornus* by the Use of a Clearing Technique (Angiospermae, Umbellales, Cornaceae).
- 3:31 185. ANDERSON, CHARLES E. (North Carolina State University). Shoot Development in *Salicornia virginica*.
- 3:44 186. PERFETTI, PATRICIA AND JAMES D. CAPONETTI (University of Tennessee). Effects of 2-Thioracil and 5-Fluorouracil on the Morphology of the Root of Bunch Bean (*Phaseolus vulgaris*).
- 3:57 187. MUSSELMAN, LYTTON J. (University of North Carolina). Anatomy of the Haustoria of the Genus *Aureolaria* Raf. (Scrophulariaceae).
- 4:10 188. EVANS, A. MURRAY AND EDWARD E. C. CLEBSCH (University of Tennessee). The Need for Floristic and Vegetation Studies in the Gorges of the Cumberland Plateau.

CRYPTOGAMIC BOTANY

Room 1452, 14th Floor

Presiding: Dr. J. T. Wyatt, East Tennessee State University

- 2:00 189. DEASON, TEMD R. (University of Alabama). Flagellar Retraction in a Xanthophyceae Alga.
- 2:13 190. COLEMAN, WILLIAM G., JR., FRISSELL R. HUNTER AND LAFAYETTE FREDERICK (Atlanta University). Studies on the Aerobic Metabolism of *Neurospora lineolata*.
- 2:26 191. SHANNON, MICHAEL C., S. K. BALLAL AND JOHN W. HARRIS (Tennessee Technological University). An Enzymatic Survey of Some *Polyporus* Species Using Starch Gel Electrophoresis (Basidiomycetes).
- 2:39 192. WARD, JOHN E., JR. AND G. T. COWLEY (High Point College and University of South Carolina). Relationship of Soil Microfungal Populations to Tree Populations.
- 2:52 193. LEONARD, RICHARD C. AND A. DOMNAS (University of Alabama and University of North Carolina). Struvite Formation in Cultures of *Pilimelia terevasa* (Actinoplanaceae).
- 3:05 194. MOYLE, SUSAN M. (University of Tennessee). Morphogenetic Studies of the Moss, *Tortula pagorum*.
- 3:18 195. TRELAWNY, GILBERT S. (Madison College). Evaluation of the Nutritional Data for *Phlyctochytrium* and *Rhizophyidium*.
- 3:31 196. HOUSTON, WILLIAM E. AND ILDA McVEIGH (Vanderbilt University). Factors Affecting Dimorphism and Growth of *Histoplasma capsulatum* (Deuteromycetes, Moniliales).

- 3:44 197. HAMMILL, TERRENCE M. (SUNY College of Forestry). Fine Structure of Conidiation in *Chloridium chlamydosporis* (Fungi Imperfecti, Hyphomycetes).
- 3:57 198. LUTTRELL, E. S. (University of Georgia). Light Intensity and Size of Conidia in *Bipolaris* spp. (Fungi Imperfecti, Moniliales, Dematiaceae).
- 4:10 199. PARKER, B. C. (Virginia Polytechnic Institute and State University). Studies of the Chemical Composition of Myxomycete Peridia.
- 4:23 200. SCHLICHTING, HAROLD E., JR. (North Carolina State University). Algae in Tobacco Beds.
- 4:36 201. HENDERSON, J. S. AND J. T. WYATT (East Tennessee State University). Physiological and Morphological Studies of the Genus *Nostoc*. I. Developmental Cycle Variation Among Species (Cyanophyceae, Hormogonales, Nostocaceae).
- 4:49 202. CAPONETTI, JAMES D. (University of Tennessee). Growth and Development of Cultured, Excised, Leaf Tips of *Osmunda cinnamomea* L. (Pteropsida, Osmundales, Osmundaceae).
- 5:02 203. HARVEY, WILLIAM H. AND JAMES D. CAPONETTI (University of Tennessee). The *in vitro* Initiation of Sporogenous Tissue on Leaves of Cinnamon Fern, *Osmunda cinnamomea* L. (Pteropsida, Osmundales, Osmundaceae).

DEVELOPMENTAL BIOLOGY AND ANATOMY

Patrick Henry Room, Mezzanine

Presiding: Dr. James Reed, Virginia Commonwealth University

- 2:00 204. BLANCHARD, ROBERT O. AND RICHARD T. HANLIN (University of Georgia). Some Aspects of the Ultrastructure of Centrum Development in *Sporormia minima* (Ascomycetes, Pleosporales).
- 2:15 205. BARTLETT, CAROL J., PATRICIA L. WALNE, OTTO J. SCHWARZ AND DAVID H. BROWN (University of Tennessee, Oak Ridge National Laboratory, Oak Ridge Associated Universities). Large-Scale Isolation of *Euglena* Eyespots by Zonal Centrifugation.
- 2:26 206. EDWARDS, NANCY C. (University of North Carolina). Macromolecular Distributions in a Developing Hydroid.
- 2:39 207. HARRISON, FREDERICK W. (Presbyterian College). Regenerative Wound Healing in *Corvomeyenia carolinensis* Harrison (Spongillidae).
- 2:52 208. REESE, MARSHALL E., JR. AND J. GORDON CARLSON (University of Tennessee). Autoradiographic Analysis of Mitotic Blockage in Grasshopper Neuroblast Cells Induced by Cold Exposure (Insecta, Orthoptera, Acrididae).
- 3:05 209. HENDERSON, VERNON (Grambling College). Origin of Fin Elements in the Channel Catfish, *Ictalurus punctatus*.
- 3:18 210. WALTON, BARBARA ANN (University of Tennessee). Histology and Histochemistry of the Embryonic Chick Mandible Following X-Irradiation.
- 3:31 BREAK
- 3:44 211. BARRINGTON, B. A., JR., M. H. KNISELY, J. MANLY STALLWORTH AND ANTONIO RAMIREZ (Medical University of South Carolina). The Mouse Ear as a Site for *in vivo* Observation of Certain Microcirculatory Phenomena.
- 3:57 212. HAMILTON, RETA (Austin Peay State University). Karyotypic Analyses of Cultured Human Leukocytes.
- 4:10 213. PAV, DENISE I. AND RANDALL W. MCKEE (East Tennessee State University). Post-natal Bone Development in Mongolian gerbil, *Meriones unguiculatus* (Mammalia, Rodentia).
- 4:23 214. KEELER, CLYDE AND LUIS SAMPER (Central State Hospital, Milledgeville, Georgia). A Case of Klinefelter Mosaicism in Man.

SYMPOSIUM

RESTORATION AND RECOVERY OF DAMAGED ECOSYSTEMS

Friday, April 16, Commonwealth Hall, Main Level

- 2:00-3:00 *Restoring Terrestrial Areas Used for Strip Mining.* RONALD D. HILL, Chief, Mine Drainage Pollution and Control Activity; ROBERT A. TAFT, Sanitary Engineering Center, Cincinnati, Ohio.
- 3:00-4:00 *Damaged Estuarine Ecosystems, Their Restoration and Recovery.* THOMAS L. LINTON, Commissioner, Division of Commercial and Sport Fishery, North Carolina Department of Conservation and Development, Raleigh, North Carolina.

4:00-5:00 *The Recovery of Damaged Streams.* JOHN CAIRNS, Jr., Director, Center for Environmental Studies, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

8:30 P.M. *Soil Destruction Associated with Forest Management and Other Uses, and Prospects for Recovery in Geologic Time.* ROBERT R.

CURRY, Environmental Geologist, University of Montana, Missoula, Montana.

The Symposium was supported in part by a grant from the Center for Environmental Studies, VPI & SU.

University of Miami Offers Tropical Botany Seminar

The University of Miami, with the cooperation of the Fairchild Tropical Garden and the U.S. Plant Introduction Station, is offering an advanced Seminar in Tropical Botany for graduate students and faculty July 14 - July 30th under National Science Foundation sponsorship. Participant support is available.

Write: Dr. Howard J. Teas, Biology Department, University of Miami, Coral Gables, Florida 33124.

University of Virginia Announces Mountain Lake Program for 1971

The University of Virginia has announced the program of graduate biology courses to be offered this summer at the Mountain Lake Biological Station in southwestern Virginia. They are as follows:

FIRST TERM - June 16 through July 21

Animal Behavior: Dr. Robert L. Jeanne
University of Virginia
Experimental Morphogenesis: Dr. James Dent
University of Virginia
Plant Ecology: Dr. Gary L. Miller
Eisenhower College
Ornithology: Dr. David W. Johnston
University of Florida

SECOND TERM - July 23 through August 26

Comparative Endocrinology: Dr. B. E. Frye,
University of Michigan

Entomology: Dr. George W. Byers
University of Kansas
Plant Biosystematics: Dr. C. Ritchie Bell
University of North Carolina at Chapel Hill
Principles of Parasitism: Dr. G. B. Solomon
The School of Veterinary Medicine, University of Pennsylvania

A limited number of National Science Foundation scholarships are available for research and study: (1) Pre-doctorate for supervised research, stipend \$500; and (2) Post-graduate for training in field biology, stipend \$400. Preference is given for studies concerned with the biota of the region. Application blanks for these awards may be secured from the Director, Mountain Lake Biological Station, Department of Biology, University of Virginia, Charlottesville, Virginia 22903 and must be submitted before May 1, 1971.

Abstracts of Papers Presented at the 32nd Annual Meeting of the Association of Southeastern Biologists

The number in parenthesis at the top of each abstract refers to the number of that paper in the program.

(92)

The Vertical Distribution and Seasonal Occurrence of Rotifera in the Main Pool of a Kentucky Reservoir

DAVID G. ABEL, *Western Kentucky University*

A study of the vertical distribution and seasonal occurrence of rotifers was conducted in Barren River Reservoir, Kentucky, between January, 1970, and January, 1971. Paired samples were collected from six depths in the main pool area of the reservoir and from an automatic plankton sampler installed in the tailwater area; the effluent was derived from the upper 3 m. (10 ft.) of the main pool. Diel studies were conducted in July and January. *Polyarthra* and *Keratella* were the dominant forms; the former was represented by three species and the latter by five species. A total of 15 genera (23 species) were encountered.

Fluctuations in numbers were detected at all depths sampled. In the winter and spring the greatest number of rotifers was at 3.0 m. (10 ft.) and in the summer and fall the greatest number was at 6.1 m. (20 ft.); the July diel study revealed that the greatest numbers consistently occurred at 20 ft. Dominant forms for each season were: Spring—*Conochilus unicornis*; Summer—*Keratella crassa*; Autumn—*Keratella cochlearis* and *Conochilus unicornis*; and Winter—*Polyarthra minor* and *Synchaeta* sp. The trends from the tailwater samples correlated positively with the surface samples reflecting major changes which occurred in the main pool.

(149)

Preliminary Report of Primary Productivity in the Okefenokee Swamp

SANDRA ADAMS AND FRED K. PARRISH
Georgia State University

Determinations of primary productivity in the Okefenokee Swamp were made by measurements of changes in dissolved oxygen and dissolved carbon dioxide. Two stations were established in isolated areas of Chase Prairie and Chesser Prairie. Measurements were taken at various times during the daylight hours from September, 1970, through January, 1971. Dissolved oxygen was determined by a YSI oxygen meter and dissolved carbon dioxide was determined by phenolphthalein titration. Other measurements taken were pH, alkalinity, air and water temperature, water hardness, water turbidity, water color, water depth, and relative humidity. General weather conditions were also recorded. Dissolved oxygen concentrations were low in the early morning and increased to a peak in the afternoon. Using S. V. Bruyevich's general equation the daily oxygen production was in the range 4.5 to 8.0 ppm.

(84)

Flora — Objectives and Analysis

ALBERT E. RADFORD, *University of North Carolina*

The objectives, the inclusions and aids, and the spectra are suggestions for comprehensive and basic organization, observation, analysis, and synthesis in flora work. Flora and vegetation objectives and inclusions are given to show the similarities, differences, and complementary nature of these two aspects of field study. In addition to learning what's where when or making a list of plant species within a given area at a given time, i.e., a simple flora, a field botany student should become acquainted with plant habit (Life Form), growth patterns (Sociability), periodicity (Phenology), duration, reproduction, spatial relations or patterns of occurrence (Population and Community), and distributional relations (Habitat and Geography). Flora study should add basic information about species biology to systematics.

(102)

Three Dimensional Ultrastructure of Myxomycetes as Viewed by Freeze-Etching

HENRY C. ALDRICH, *University of Florida*

Physarum flavicomum and *Didymium ovoideum* plasmodia and sporangia at spore cleavage were examined by sectioning and by freeze-etching preparative procedures. The latter involved glutaraldehyde and osmium simultaneous fixation followed by glycerol treatment and standard freeze-etch steps. Nuclei are smooth, with numerous pores evident over the surface. Mitochondrial membranes have a beaded appearance with depressions on the inner membrane corresponding to connections to the tubular cristae. Capillitial vacuole surfaces have plaque-like areas on their membranes. The plasmodial plasmalemma exhibits numerous particles and occasional invaginations into the cytoplasm. The advantages of using stereo techniques to achieve three dimensional views of the structures involved will be emphasized.

(107)

Homogeneity of Sex Difference in Recombination Frequency in Linkage Group VI of the Mouse

W. ST. AMAND, *University of Mississippi*

Recombination frequency estimates from phase-balanced three-point backcross matings with Hightail, an as yet undescribed mutant in linkage group VI, and the markers Caracul and belted are as follows: With heterozygous males, Ca-Ht, 4.88 ± 0.57 ; Ht-bt, 7.80 ± 0.70 .

With heterozygous females, $Ca-Ht$, 1.72 ± 0.34 ; $Ht-bt$, 5.36 ± 0.59 . For both intervals the sex difference is highly significant.

An analysis of all data available for loci in this linkage group shows homogeneity in the sense of sex differences and suggests that the magnitude of sex difference is a function of segment length.

(185)

Shoot Development in *Salicornia virginica*

CHARLES E. ANDERSON
North Carolina State University

Several species of *Salicornia* have been described as inhabiting the North Carolina salt marshes. Their habitat ranges from low marsh, that regularly floods, to the salt barrens of the high marsh. These plants may be found over a wide salinity range and are tolerant of rather severe currents. *Salicornia* is described in the taxonomic literature as a leafless plant. However, it does have leaves which are appressed to the stem and extend the length of the internode. The expansion of the leaf and stem is synchronized, both structures being extended by separate intercalary meristems. Among the peculiar anatomical features of the plant are tracheoidioblasts among the cells of the leaf palisade layer, bridges which form between cells of the ground tissue, and secondary growth produced by two cambia, one giving rise to vascular bundles and ground tissue and the other producing a periderm.

(19)

Seed Germination Inhibition by Leaf Extracts of *Swietenia mahoganii* Jacq. (Meliaceae)

HOWARD ANDORFER, University of South Florida
AND
HOWARD TEAS, University of Miami

Field observations on the indian mahogany, *Swietenia mahoganii*, suggested that inhibition of seedling germination or seedling establishment by parent plants might be involved in its distribution. Aqueous mahogany leaf, but not root, extracts caused strong seed germination inhibition in mahogany and several of a wide range of other species. Seed of flax, *Linum usitatissimum* L. (Linaceae), which were inhibited by leaf extract, were utilized as an assay organism because of their rapid germination. The inhibitory factor was found to be stable to boiling water and soluble in diethyl ether. Further extraction and separation by solvents and paper chromatography indicated that the inhibitory fraction was probably a single ether-soluble organic acid. (Research supported by the National Science Foundation through the Advanced Seminar in Tropical Botany (GZ-1523) at the University of Miami in 1970.)

(59)

The Effects of Stratification, Light, and Temperature on the Germination of Sweetgum (*Liquidambar styraciflua*) Seeds (Angiospermae: Rosales: Hamamelidaceae)

GAIL SYDNEY BAKER, Mississippi State University

Previously, the seeds of sweetgum were considered to be dormant and stratification was the usual method of breaking dormancy and overcoming the light require-

ment. This study has shown that the light conditions during stratification have a definite effect on subsequent germination in the dark, and that stratification in the dark does not completely overcome the light requirement. Although stratification does increase germination rate at the lowest temperature regime (20° - 30° C), it is not necessary at the more optimal temperatures (25° - 35° and 30° - 40° C). In fact, considerable germination occurred in the dark at the alternating 30° - 40° C regime.

(144)

Protozoan Succession in Autumn Leaves

STUART S. BAMFORTH
Newcomb College of Tulane University

The phyllosphere is a specialized habitat influencing the manner of protozoan succession. Living leaves with cutinized surfaces, such as live oak and supplejack, support low protozoan densities of less than 100/g dry weight of leaf. Other leaves, such as elm, hackberry and maple, support protozoan densities of 100 to 800/g. Usually over 70% of the protozoa are *Colpoda cucullus*; less than 20% are *Colpoda steini*, and the remaining organisms are a few other ciliates. When the leaf dies, the numbers of these two *Colpodas* increase, but *C. cucullus* becomes less prominent due to the appearance of small flagellates, which can comprise over 50% of the population. Protozoan densities number from 400 to 12,000/g. When the leaves fall into the litter, densities rise to 3,000 to 60,000/g. Flagellates are still as prominent, but *C. steini* becomes more prominent than *C. cucullus*. The reasons for the shift in populations will be discussed.

(83)

Distributional Analysis of *Quercus alba* L. (Fagaceae) in the Southern Appalachians

MICHAEL J. BARANSKI, North Carolina State University

As part of a total analysis of variation of white oak in the Southern Appalachians, a study was conducted to determine the presence or absence of two or more elevational ecotypes within the species. Sample sites, representing a diversity of topographic and moisture conditions, were located along the entire elevational gradient available. Sites were arranged into moisture classes according to composition of vegetation. The relative percentage of abundance and cover of white oak was estimated. This study demonstrates that there is no real altitudinal hiatus in existence between low and high elevation populations. White oak occurs continuously along the elevational gradient on sites conducive to its growth, and appears to have the potential to occur with relatively equal frequency wherever it grows. The factors affecting its distribution have not been identified.

(46)

Forest Floor Populations of Carabid Beetles (Coleoptera: Carabidae) on the Blue Ridge Escarpment in North Carolina

THOMAS C. BARR, JR., University of Kentucky

Ground beetle populations of the floor of an oak-hickory forest near Highlands, North Carolina, were investigated using a 30-m octagonal fenced wire arena with 8 pitfall traps at the interior margin. The relative abun-

dance of the 27 species recorded between June 23 and August 23, 1970, approximates a log-normal distribution. The two most abundant species, *Carabus limbatus* and *Pterostichus (Cylindrocharis) acutipes*, were more frequent in the traps (presumably reflecting greater foraging activity) during warmer weather. *C. limbatus* was more frequently trapped under drier conditions, while *P. acutipes* appeared more frequently in rainy weather. The average activity area of the former species was about 2.3 times greater than that of the latter. Population density of *C. limbatus* was estimated to be about 0.8 that of *P. acutipes* by both the Lincoln-Peterson and direct count methods.

(100)

Neutral Lipid Composition of the Tobacco Budworm, *Heliothis virescens* (Fab.), as Affected by its Habitual Parasite, *Cardiophiles nigriceps* Viereck

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Troy State University

Neutral lipids of haemolymph and tissue of non-parasitized and parasitized *Heliothis virescens* (Fab.) [Lepidoptera: Noctuidae] and its insect parasite, *Cardiophiles nigriceps* Viereck [Hymenoptera: Braconidae], were fractionated into individual classes by a combination of silicic acid and Florisil column chromatography. Triglycerides were the predominant fraction in all groups and accounted for 48-60 per cent of the neutral lipid matter. Sterol esters were second to triglycerides in solid tissue and haemolymph samples and made up 10-18 per cent of the total neutral lipids. These two fractions were followed closely by the free fatty acid (8-9 per cent) fraction. Fatty acid analysis of the different neutral lipid spectra revealed the presence of two major fatty acids (palmitic and oleic acid) and several minor fatty acids (myristic, myristoleic, palmitoleic and linoleic acid). The free fatty acid fraction of the neutral lipid spectrum was the most representative fraction found in the host and parasite.

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(211)

The Mouse Ear as a Site for *in vivo* Observation of Certain Microcirculatory Phenomena

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J. MANLY STALLWORTH² AND ANTONIO RAMIREZ³

The ear of the white laboratory mouse provides a suitable but little used site for *in vivo* observation of circulating blood. No surgical procedures are necessary. The ear is coated with a neutral mineral oil and carefully spread flat on a slide for support. It is then transilluminated through an ordinary microscope condenser, or other device, and studied in detail with a compound microscope. We have used this method to examine and demonstrate normal circulation of unagglutinated blood in healthy anesthetized mice, to study vessel responses, and to examine intravascular aggregates in various pathologic conditions. This preparation provides a useful and inexpensive means of demonstrating many aspects of nor-

mal mammalian circulation in the teaching laboratory and is also a useful tool for investigative purposes. (These studies were supported in part by USPHS Grants HE-04176, HE-05340 and The John A. Hartford Foundation.)

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(205)

Large-Scale Isolation of *Euglena* Eyespots by Zonal Centrifugation (Euglenophyceae, Euglenales, Euglenaceae)

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University of Tennessee, Knoxville; Biology Division,
Oak Ridge National Laboratory; and Medical
Division, Oak Ridge Associated Universities,
Oak Ridge, Tennessee

Large volumes of eyespot granules were isolated from homogenates of *Euglena gracilis* var. *bacillaris* by centrifugation in a B-XV zonal rotor in a sucrose density gradient. The granules were further purified by centrifugation through a sucrose density gradient in a swinging bucket rotor and banded at the interface of the sample and the buffer overlay. Examination with the electron microscope showed the eyespot granules to be free from other cellular material. Freezing had no apparent effect upon eyespot structure or on their absorption properties. Absorption spectra of pure fractions of eyespot granules showed a peak at 675-700 nm, which suggests that a phytochrome system may be located in the granules. The techniques of rate and isopycnic zonal centrifugation for the isolation of eyespot granules from *Euglena gracilis* is compared with methods which have employed conventional centrifugation, and the significance of the use of zonal rotors for isolating large quantities of pure eyespot granules is discussed.

(26)

Germination of Winter Annuals in July, and Survival of the Seedlings

CAROL C. BASKIN AND JERRY M. BASKIN
University of Kentucky

A 3-day period of abnormally low temperatures during July, 1970, caused germination of seeds of 17 species of winter annuals, which normally do not germinate until September and October. Summer germination during this abnormally low temperature period supports conclusions from previous laboratory and greenhouse studies that temperature is the overriding factor controlling germination in the field during July and August. Seedling survival in the July-germinated seedlings during the remainder of the summer was zero in most of the species and very low in the others. The failure of these seedlings to survive supports our conviction that the inability of seeds of winter annuals to germinate in summer at the high summer temperatures is a physiological adaptation to the summer-dry habitats of the cedar glade environment.

(25)

The Possible Ecological Significance of the Light-Requirement for Germination in *Cyperus inflexus*

JERRY M. BASKIN AND CAROL C. BASKIN
University of Kentucky

In the cedar glades of central Tennessee, seeds of *Cyperus inflexus* Muhl. exhibit true dormancy at maturity in autumn. In nature dormancy is broken by low-temperature after-ripening (stratification) during the winter, and seeds germinate the following spring. After-ripened seeds are positively photoblastic and, therefore, require a light treatment for germination. The light requirement was not fulfilled by exposing dormant resting seeds to light during "duplicated" fall and/or winter conditions, and after-ripened seeds that did not receive several photoperiods after removal to "duplicated" spring conditions germinated poorly or not at all. The absolute light requirement for germination after conditions become favorable for germination in the spring may be of ecological significance in restricting *C. inflexus* to its shallow-soil habitat where there is little vegetation and litter to obstruct light from the soil surface.

(78)

Trends to Specialized Pollination in the Apiaceae

C. RITCHIE BELL, University of North Carolina

Each insect visitor to the unspecialized flowers of an umbel is a possible, and probable, pollinator; reports of 200-300 different species of pollinators for a single species of umbel are not unusual. Most of these unspecialized pollinators are Diptera and the less specialized Hymenoptera. The oils found in many umbels may deter the expected visits by the unspecialized, chewing or sucking Coleoptera and Hemiptera. A comparison of reported pollinators, by percentage, for a number of species in different genera indicates a possible trend away from promiscuous pollination and toward a more constant, perhaps specialized, pollinator relationship between *Sanicula marilandica* and certain short-tongued bees; between *Eryngium yuccifolium* and Lepidoptera; and between *Pastinaca sativa* and certain Coleoptera.

(151)

A Laboratory Investigation on the Function of the External Secretion of the Whirligig Beetle, *Dineutus discolor* (Coleoptera: Gyridae)

ERNEST F. BENFIELD
Virginia Polytechnic Institute and State University

Laboratory experiments were performed using three potential predators to determine whether the external secretion of *Dineutus discolor* can function as a chemical defense mechanism. Predators employed were the bluegill, *Lepomis macrochirus* Raf., the rainbow trout, *Salmo gairdneri* Rich and the common newt, *Notophthalmus viridescens* Raf. Results indicated that the predators found both the beetles and more normal food coated with the secretion from the beetles to be distasteful.

Bioassays employing crude secretion demonstrated that the secretion, when borne on the water surface, can initiate an alarm response in groups of quiescent beetles.

(36)

Pre-Impoundment Water Quality Survey on the New River: A Preliminary Report

ERNEST F. BENFIELD, KENNETH L. DICKSON,
DAVID P. KLARBERG AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

This investigation was prompted by a proposed plan for the construction of a pump-storage reservoir system on the New River in Grayson County, Virginia. A total of twenty sampling stations, strategically selected to include major tributaries and industrial outfalls as well as the main river course, were established along the New River in North Carolina, Virginia and West Virginia.

Two bottom fauna surveys were planned for each of the twenty stations. The first collection was completed in August, 1970; a second collection will begin in late April, 1971. Data accumulated in these collections are to be submitted to taxonomic and community structure analyses.

Physical and chemical water quality parameters are monitored at nine stations on a bimonthly schedule. Physical parameters being examined include temperatures, specific conductivity, turbidity, total and dissolved solids, and flow. Chemical parameters being monitored include pH, nutrient ions, heavy metals, and fourteen other ionic species. (This research is supported by the Appalachian Power Company.)

(204)

Some Aspects of the Ultrastructure of Centrum Development in *Sporormia australis* (Ascomycetes: Pleosporales)

ROBERT O. BLANCHARD AND RICHARD T. HANLIN
University of Georgia

Studies on ascocarp development in *Sporormia* with the light microscope have shown that it is characterized by the downward growth of pseudoparaphyses into a cavity with subsequent elongation of the asci upward among the pseudoparaphyses, which disintegrate as the asci mature. These studies have not revealed the nature of the cavity or of the origin of the ascogenous hyphae. Studies with the electron microscope on *S. minima* have shown that a cavity is formed by the disintegration of cells in the center of the young ascostroma and that the ascogenous hyphae arise as outgrowths of the cells lining the bottom of the cavity. Although the ascogenous hyphae are deeply staining, the cells from which they arise cannot be differentiated from the stromal cells adjacent to them. The ascogenous hyphae branch and form a network along the base of the cavity. (This research was supported in part by National Science Foundation Grant No. GB-12060.)

(147)

Nitrogen Fixation in Escambia Bay

BETTY J. BOHANNON AND JOE A. EDMISTON
University of West Florida

A survey of nitrogen fixation in the sediments of Escambia Bay was made during the fall of 1970. Mud sediments collected from the bay floor were tested for nitrogen fixation by the acetylene reduction test of Stewart, Fitzgerald, and Burris (1967). Preliminary results indicate that although nitrogen fixation occurs throughout most of the bay floor, some sampling sites repeatedly yield sediments which do not reduce acetylene.

The pattern of nitrogen fixation in Escambia Bay and factors which might be causing inhibition of nitrogenase activity at the negative sampling sites will be discussed.

(123)

Ontogenetic and Behavioral Color Patterns in the Sand Perch, *Diplectrum formosum* (Pisces: Serranidae)

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Institute of Marine Sciences, University of North Carolina

Field and laboratory observations on the sand perch, *Diplectrum formosum* (Linnaeus) indicate that color patterns may be associated with growth and changes in activity. Juvenile sand perch (< 75 mm SL) generally display a dark horizontal stripe body pattern. On slightly larger fish (75-125 mm SL) these horizontal stripes have an interrupted appearance coinciding with the occurrence of 7-8 dark brown vertical bars. Adults (> 125 mm SL) display these vertical wedge shaped bars with little remnant of the horizontal stripes. Colors on the pharyngeal and belly regions also change with fish size. Laboratory observations confirm a diurnal activity cycle in juvenile sand perch. Active swimming fish display a distinct horizontal stripe pattern. These same specimens, when inactive, show a vertical bar pattern. This pattern can change quickly (within 3 sec.) as fish alter their activity. If undisturbed juvenile sand perch display only the vertical bar pattern at night.

(108)

Polarized Cylindrical Bodies in the Epididymis of *Tamias striatus*

PAT I. BROWN AND JAN MARTAN

Southern Illinois University

In the upper caput epididymidis of the eastern chipmunk, individual spermatozoa associate to form cylindrical bodies. Spermatozoan heads, all oriented in the same direction, are spaced on the periphery of these bodies, while their tails are inside the cylinders. In the lower caput and upper corpus of the epididymis, cylindrical bodies dissociate into individual spermatozoa. These alterations in spermatozoan associations probably result from changes in their cohesive properties. Whether these changes are intrinsic to the spermatozoa or are caused by some epididymal function is not certain at present. In the chipmunk, principal epithelial cells of the epididymis contain an unusual amount of cytoplasmic RNA. Ribonucleic acid is located not only around the nuclei, but also atypically in the apical portion of the epithelial cells along the entire epididymal duct. The peripheral position of spermatozoan heads facing the apical parts of the epithelium suggests some epididymal influence.

(155)

Root Inundation as a Factor Affecting the Vertical Position of *Spartina alterniflora* in Coastal Marshes

SAMUEL D. BROWN AND WILLIAM H. QUEEN

University of South Carolina

Daily duration of root immersion as a factor affecting the vertical distribution of *Spartina alterniflora* in Atlantic coast salt marshes was studied. Plants growing in marsh

mud in the greenhouse were subjected to three root immersion treatments with artificial sea water having a salinity of 18 ppt. The treatments were: (1) daily watering, (2) flooding in accordance with natural tidal cycles, and (3) continuous flooding. After four weeks of treatment, photosynthetic rates (gross) for plants in the three treatments (watered, tidal, flooded) were found to be 17.6, 17.5 and 15.0 mg CO₂/hr/dm² while respiration rates were 2.6, 1.8 and 1.7 mg CO₂/hr/dm² respectively. The ratios between the two processes being 6.8 for watered, 9.7 for tidal and 8.8 for flooded. These ratios, which are indicative of the amount of food available for growth, suggest that *Spartina alterniflora* is best adapted to a tidal environment.

(152)

Distribution and Species Composition of Zooplankton in Reservoirs

DEWEY L. BUNTING, *University of Tennessee*

Material for this report was taken from reservoirs in eight states, with special emphasis on the T.V.A. system. Zooplankton species were grouped into several categories relating to their distribution patterns. For the majority of species, high correlations existed between reservoir distribution, drainage system, and geographic range. Some species appear to be primarily related to the reservoir environment. They did not occur in surrounding lakes and ponds, their distribution was spotty, which may indicate water quality effects, and they all appeared to be outside their known geographical ranges. Some of these appear to be recent invaders of the T.V.A. system. One marine species, previously known from the Great Lakes and coastal lakes, was taken in reservoirs in Texas, Oklahoma, and Arkansas. The last group contains species thought to be vernal pond forms. These were probably recruited by inundation of ponds during reservoir filling, and have since become established. At least one of these species is a common spring form in many of the T.V.A. reservoirs.

(128)

Ecological Studies of Marsh Vegetation Along a Short, Highly Disturbed River Ecosystem

C. JOHN BURK, *Smith College*

Studies of marshes which have developed behind impoundments on the Mill River, a stream fourteen miles in length located in Northampton and Williamsburg, Massachusetts, indicate that diversity and total coverage of vascular plant species decrease in all zones of the downstream marshes while the tendency towards large single-species stands increases. An Old World species, *Marsilea quadrifolia* L., known to have escaped from cultivation some time after 1940 and since then established along the edges of one impoundment and two miles of a diversion channel, invaded the lowermost marsh in 1969 and spread throughout that marsh during summer, 1970. These changes and variations in marsh composition are correlated with disturbances, including pollution and abrupt changes in the water level, which result from human activities in the lower portions of the river. The sources and nature of harmful substances in the stream and its sediment deposits will be discussed.

(168)

A Preliminary Study Which Supports the Mucous Coagulation-Suffocation Hypothesis in Fish Exposed to Acutely Toxic Concentrations of Zinc

DENNIS T. BURTON, ALMA H. JONES AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

A number of theories have been proposed to explain the mechanism of acute zinc toxicity to fish. This study was initiated to test the hypothesis that coagulation of mucous on the gills of fish kills them by suffocation. Suffocation induced by exposure to low dissolved oxygen concentrations causes a large increase in lactate concentrations in the skeletal muscle of fish. Burton (paper in prep.) has demonstrated that rainbow trout exposed to low dissolved oxygen concentrations produce large amounts of muscle lactate with subsequent reductions in pyruvate.

Rainbow trout (*Salmo gairdneri*) were exposed to a concentration of 40 mg Zn⁺⁺/l in a well oxygenated, continuous water flow system. Skeletal muscle lactate and pyruvate were measured in control fish and fish killed by Zn⁺⁺. Zinc killed-fish had a 170 percent increase in lactate when compared to controls and a 160 percent decrease in pyruvate when compared to controls. These data support the hypothesis that one of the major mechanisms of death in fish exposed to acute Zn⁺⁺ toxicity is that of suffocation.

(202)

Growth and Development of Cultured, Excised, Leaf Tips of *Osmunda cinnamomea* L. (Pteropsida: Osmundales: Osmundaceae)

JAMES D. CAPONETTI,
The University of Tennessee, Knoxville

Excised tips of certain leaf primordia were placed in a sterile, agar medium of inorganic salts plus sucrose concentrations of 2 to 10% for varying periods of time. Increasing sucrose concentrations up to 8% induced a progressive increase in final leaf height of frond primordia, and sucrose concentrations up to 10% progressively augmented the number of pinnae pairs. In spite of the fact that the excised leaf tip has an organized, meristematic region much like the apical meristem of the shoot, the mature leaf produced lacked the basal portion of the petiole. Bud scale primordia presented a different picture. Increasing sucrose concentrations produced a progressive inhibition in height and in number of pinnae pairs. Although they were prospective bud scales, they developed into fronds, but, as in the frond primordia, they also failed to regenerate the basal portion of the petiole.

(5)

Variation in the Frequencies of the Striped and Unstriped Forms of the Salamander *Plethodon cinereus cinereus* (Urodela: Plethodontinae) on Potts and Salt Pond Mountains, Giles County, Virginia

JOSEPH P. CHINNICI, *Virginia Commonwealth University*
MARY ANN ANGLEBERGER, *University of Virginia*

A three mile transect, consisting of 17 samples of the polymorphic red-backed salamander, *Plethodon cinereus cinereus*, was taken along Route 613 on Salt Pond and

Potts Mountains, Giles County, Virginia during July and August of 1970. The sample sizes ranged from 49 to 112 individuals, and most samples were taken at one-half to one-eighth mile intervals along Route 613 north of the Mountain Lake Biological Station. A total of 1106 individuals were sampled in a 26 day period. A shallow, approximately 10 foot wide stream, Little Stony Creek, runs perpendicular to Route 613 and bisects the transect area. The frequency of the unstriped morph of *P. cinereus* varies from 6 to 15 percent in the 13 samples taken north of Little Stony Creek, but this frequency drops to from 0 to 1 percent in the 4 samples taken south of the stream. Possible ecological factors acting to maintain the disparity in morph frequencies in the samples taken north and south of the stream will be discussed.

(179)

Comparative Studies within Two Species of *Luzula* (Juncaceae)

JANICE C. COFFEY, *Queens College*

Luzula spicata (L.) DC. and *L. parviflora* (Ehrh.) Desv., which occur at high altitudes and latitudes in North America, are morphologically highly variable species, having been subdivided by several investigators using primarily morphological criteria. A more complete study of these species is being conducted and this report presents the results of morphological, cytological, physiological, and chemical studies of these species found in two widely separated areas of North America, namely the mountainous areas of New England and Colorado. The occurrence and patterns of secondary compounds in these species have not been previously reported.

(39)

Rain Forest Decapod Crustaceans: I, A Systematic Survey

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The University of West Florida

The freshwater decapod fauna of mountain streams in the Loquillo Experimental Forest, Puerto Rico, were studied during a two week period in December, 1970. Distribution, ecology, life cycle, and taxonomic relationships were stressed in this study. Collections comprised of representatives from the Atyidae and Palaemonidae, and the brachyura family, Pseudothelphusidae. Several discrepancies from previous descriptions, primarily concerning the atyid shrimps, were noted. Observed also was the presence of a form of *Atya lanipes* previously unreported from Puerto Rico. Discussion of the rostral length in *Xiphocaris elongata*, the life cycles of atyid shrimps in the mountain stream habitat, and the potential for culture of several species is presented.

(170)

Toxicity of ZnSO₄ to the Crayfish *Cambarus bartonii*

MARILYN ADAMS COLEMAN AND ALAN G. HEATH
Virginia Polytechnic Institute and State University

The approximate time to death in six different concentrations of ZnSO₄ was measured. Sixty-two animals were used for the experiment. Ten to twelve in each of the following concentrations 0, 100 ppm, 200 ppm, 300 ppm, 400 ppm, 500 ppm. The crayfish were tested at a

constant room temperature of 20° C under a 12 hour photoperiod. Total hardness of the dilution water was 51 mg/liter. The average pH was 7.9. Acclimation time to lab conditions was two weeks. Crayfish weights ranged from 24-32 grams. Only one crayfish was used per 2.7 liter glass container with 1 liter of solution. Under these conditions, the 96 hour median tolerance limit was 175 ppm for the crayfish *Cambarus bartonii*.

(190)

Studies on the Aerobic Metabolism of *Neurospora lineolata*

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Oxygen consumption was measured by the direct method of Warburg. Fumaric acid, alanine, glutamic acid and aspartic acid stimulated the oxygen consumption of sucrose grown mycelia of *Neurospora lineolata* at pH 6.5. Citric acid, trisodium isocitrate, alpha-keto-glutaric acid, fumaric acid, alanine, glutamic acid, aspartic acid, sodium acetate, and maltose stimulated oxygen consumption of acetate grown mycelia of *Neurospora lineolata* at pH 6.5. Spectrophotometrically, citrate synthetase, aconitase, NAD-isocitrate dehydrogenase, malate dehydrogenase, fumarase, isocitrate lyase and malate synthetase were demonstrated in mycelial free extracts of sucrose grown *Neurospora lineolata*. The results suggest the operation of the tricarboxylic acid cycle and/or glyoxylate shunt mechanisms in *Neurospora lineolata*, and that different metabolic pathways may be induced by different environmental circumstances. (Supported in part by the Atlanta University Center Research Committee and the Research Corporation - Brown Hazen Fund.)

(126)

Interesting New Locality Records for the Southern Cavefish, *Typhlichthys subterraneus* Girard (Pisces, Amblyopsidae)

JOHN E. COOPER
Community College of Baltimore and
National Speleological Society

Recent collecting has helped delineate the range of *Typhlichthys subterraneus* at its southern and eastern edges. An apparently isolated population has been found in the Mississippian Plateaus of southeastern Kentucky. Two populations, including the first for Georgia, are known in north-flowing tributaries of the Tennessee River drainage, and several collections have been made from south of the Tennessee. Another locality in the Coosa drainage of the Mobile basin has been discovered.

(42)

Studies of the Aquatic Ecology of Shelta Cave, Huntsville, Alabama

JOHN E. COOPER, Community College of Baltimore
and National Speleological Society
AND
MARITHA R. COOPER, National Speleological Society

Shelta Cave, Huntsville, Alabama, houses an aquatic fauna which is probably the most complex known in any cave. This aquatic community includes some 22 species, 10 of which are troglodytes. Occasional collections and

observations have been made in the cave for at least 40 years. Our observations date from 1963, and an intensive ecological study of the aquatic community, emphasizing the 3 sympatric species of troglodytic crayfishes, was begun in the fall of 1968. Each crayfish processed has been given an individual number which lasts until the animal molts, as well as a permanent dye injection. Nearly 1,700 numbers have been assigned to individual crayfish, many of which had molted after an earlier marking. About an equal total of numbered recoveries have been made as well. Information thus gained will yield comparative data on reproduction, growth and molting, movements, population size and structure, social interactions, habitat preference, marking techniques, possible character displacement, and other factors.

(87)

Comparative Morphological Study of Five Tribes of Cercopinae (Insecta: Homoptera: Cercopidae)

DANICE H. COSTES, Troy State University

Morphological characters and combinations of characters were found that were useful in comparative studies of certain higher categories of Cercopidae.

Five tribes of Cercopinae, namely Ischnorhinini Schmidt, Tomaspidini Jacobi, Cercopini Leach, Tiodini, new tribe and Monecphorini, new tribe are defined and compared; their included genera are also compared based on their similarities and differences. In addition to the new tribes listed above, four new genera and seven new species are described. The major emphasis of this study is on the male genitalia; 313 illustrations are presented.

(10)

Sexual Dimorphism of the Sound Producing Mechanism of the Striped Cusk-Eel, *Rissola marginata* (Pisces: Ophidiidae)

WALTER R. COURTENAY, JR., Florida Atlantic University

The relationships of the swimbladder, modified anterior vertebral components, and associated musculature indicate a primary function of sound production in the striped cusk-eel, *Rissola marginata*. Sexual dimorphism is marked in these structures. In males it is manifested externally as a hump on the occiput. The swimbladder is partially ossified and differs in morphology from that of females. Sound producing mechanisms involving similarities of swimbladder-muscle relationships in 15 nominal teleost families may form a basis, together with other characteristics, for a reconsideration of present phylogenetic interpretations.

(28)

Mesic Hardwood Hammock Nature Trail

SHARON J. CREIGHTON AND JOE A. EDMISTEN
The University of West Florida

Most of the semi-virgin forest on The University of West Florida campus will be used in expansion of facilities. Efforts are being made to save sections. A mesic hardwood hammock section, located on a steep bank at the edge of a bayhead, is to become a nature trail. Vegetation was studied by the quarter method, Phillips (1959), and by listing major species. Abiotic factors have been

documented. Animals were subjectively sampled. This study should enable others to study this area and to use this as a comparison study when changes occur there due to campus expansion and/or pollution of the area. Ek-tachrome slides of the area will be shown.

(49)

Indices of Fish Species Diversity as Pollution Indicators

MICHAEL D. DAHLBERG

Virginia Institute for Scientific Research

Numbers and graphs that represent population or community structure are widely used in pollution studies as they are generally considered to be more sensitive and reliable than so-called "indicator species." Diversity generally decreases with pollution. Two components of diversity are richness, dependent primarily on numbers of species, and the equitability or evenness of the distribution of individuals among the species.

The number of species found within an area is a simple index. Within Georgia, the numbers of native and introduced freshwater fishes in six drainage systems ranges from 52 to 102. The numbers of fish species in Georgia coastal habitats range from 22 in a tidal canal and brackish pool to 114 along a beach.

Seasonality was determined for four numerical indices in an unpolluted Georgia estuary. Correlated with seasons there were significant changes in relative abundance (equability and evenness indices) but not in richness or the Shannon-Wiener index (which combines the two components). Indices did not change from high to intermediate salinities.

Weights, lengths, and numbers of individuals in accumulative samples of estuarine fishes from one station were used to construct Preston log-normal curves and dominance-diversity curves. Size parameters are of greater value than individuals.

(154)

Mathematical Models for Growth in Intertidal Oysters

RICHARD F. DAME, *University of South Carolina*

Growth was determined from the monthly increase in weight of marked oysters held in a wire box suspended in the intertidal zone beneath a dock at North Inlet, South Carolina. The seasonal variation in water temperature, T , was best expressed by the relationship $T = \alpha + \beta \sin D$ where D is the time of year in angular degrees, α and β are the regression coefficients. Percentage increase in weight, P , of whole oysters less than 50 grams was found to fit the equation $P = \alpha + \beta T$. Oysters greater than 50 grams whole weight failed to fit any reasonable relationship for percentage increase in weight, apparently because of energy expended in reproduction. The total live weight, W , of individual oysters of different size classes can be predicted at any time during the year from the general relationship $W = \alpha + \beta Q$ where Q is cumulative day-degrees following initial weighing. The relationship between whole live organism weight and dry body weight, B , did not change significantly during the year and was $\log B = \log \alpha + \beta \log W$. Caloric content of dry bodies had a mean value of 5059 calories/gram. From the preceding models, growth of whole oysters and dry bodies could be computed in terms of weight and energy for natural populations of intertidal oysters at North Inlet.

(61)

The Control of Male Differentiation in *Volvox aureus* M5

WILLIAM H. DARDEN, JR., *University of Alabama*

Male differentiation in the M5 strain of *Volvox aureus* has previously been shown to be controlled by a diffusible hormone. In this paper we report the preparation of a cell-free extract from *Volvox* which shows little ability to induce male differentiation alone but which has high inductive activity when combined with calf thymus histones.

(50)

The Plant and Animal Associations of the Diamond Crystal Salt Ponds

J. S. DAVIS, *University of Florida*

From a two year study of the organisms in the salt ponds of the Diamond Crystal Salt Company, Long Island, Bahamas, a comprehensive list of both plants and animals growing in brine ponds of varying salinities has been obtained. Included are vascular plants, fish, insects, ciliates, algae, and bacteria. The blue-green algae and bacteria are the predominant organisms in all the ponds. In addition to presenting the list of organisms encountered, the role of micro-organisms in the production of salt will be discussed.

(176)

Long Term Effects of Blinding, or Blinding and Pinelectomy and Thyroxine on Locomotor Activity Patterns, Water Consumption and Organ Weights in the Rat (Mammalia: Rodentia)

KENNETH B. DAVIS, *Memphis State University*

KENNETH DICKSON, *University of Tennessee, Medical Units*

Studies concerning the effect of the pineal gland in mammals suggest an antagonistic effect on several endocrine organs. These effects are thought to be mediated by the photoperiod by way of nervous pathways from the eye to the pineal. Most studies have been short term in nature. The present study was designed to determine the effect of blinding, and blinding plus pinelectomy on several endocrine tissues and on locomotor activity patterns. Thirteen two month old white rats were bilaterally enucleated; six of the animals were also pinealectomized. Five rats of the same age were not operated on and served as controls. The animals were housed individually and maintained on a 12-12 L:D photoperiod. Fifteen months later ten of the animals were placed in activity wheels which were connected to an event recorder. Water consumption was measured daily. Activity was recorded for several days. The animals were presented with thyroxine (1 mg/Kg/day) in the water for twelve days. Thyroxine was removed for seven days and the animals were then presented with thiouracil in the water. Five days after the end of the thiouracil treatment the rats were sacrificed. The effect of thyroxine and thiouracil on locomotor activity was analyzed. The weights of the pituitary, thyroid, adrenals, and gonads were compared for the three groups.

(189)

Flagellar Retraction in a Xanthophyceyan Alga

TEND R. DEASON, *University of Alabama*

Zoospores of the xanthophyceyan alga, *Pseudobimil-leriopsis*, swim actively for a few minutes to an hour after release from the sporangium. After they lose motility, they may move in an amoeboid fashion briefly, and then retract their flagella. The long flagellum lashes around the cell body and is drawn inside the cell membrane. The basal swelling, typical of heterokont algae, loses its electron density, the basal bodies migrate inward, and the flagella disappear. Cell wall formation begins almost immediately after the spores become spherical.

(125)

Fishes Associated with Pelagic *Sargassum* in the Florida Current

JAMES K. DOOLEY

Fishes associated with pelagic *sargassum* in the Florida Current off Miami were studied for 14 months (April 1966 — May 1967). Fishes and weed were collected using a miniature purse seine. Analysis revealed approximately 8,400 fishes belonging to 8 orders, 23 families, 36 genera and 54 species. The families Carangidae (14 species), Balistidae (14 species) and Antennariidae (1 species) numerically comprised 90 percent of all fishes. Summer and fall were marked by fewer, larger fishes than winter and spring. Preliminary examination of *sargassum* fishes in other areas of the North Atlantic showed a decline in species numbers with increasing latitude. The *sargassum* complex is responsible for the transport of many species of pelagic, littoral and benthic fishes and is important in their life histories, providing them with a substratum, food and shelter.

(79)

The Effect of Four Herbarium-drying Methods on Corolla Lobe Shrinkage in *Matelea* (Angiospermae: Apocynales: Asclepiadaceae)DONALD J. DRAPALIK, *Georgia Southern College*

Living flowers from nine species of *Matelea* were pressed and subjected to four herbarium-drying methods: (1) solitary flowers, dried by room fan; (2) solitary flowers, dried over heater; (3) flowers with other aerial plant parts, dried by room fan; and (4) flowers with other aerial plant parts, dried over heater. Considering all species as a whole, shrinkage was lowest (13% and 20% average for corolla lobe length and width respectively) under Method 1 and highest (38% and 38% average, respectively) under Method 4. Maximum shrinkage (59% and 68% maximum, respectively) was observed under Method 4. Under all methods some particular corolla lobes exhibited extreme differential shrinkage in regards to their length and width, and length/width ratios obtained from such lobes would yield meaningless data. I recommend that future authors of plant keys and descriptions indicate whether structural dimensions were obtained from living specimens, herbarium specimens, or other.

(22)

The Nitrogen Budget of a Tropical Rain Forest

JOE A. EDMISTEN, *University of West Florida*

N^{15} , acetylene reduction, and kjeldahl techniques are being used to construct a nitrogen budget for the El Verde Forest in Puerto Rico. Early results suggest a total input of about 103 lbs. of N/acre/year coming from rain (13), epiphyllae (65), root nodules (25). About 86 lbs./acre/year appear to be recycled from a soil reservoir while about 27 lbs./acre/year are lost in drainage water. This paper will emphasize current studies designed to refine this preliminary model. These studies deal with the possibilities of losses due to denitrification and addition due to fixation by tree trunk organisms.

(206)

Macromolecular Distributions in a Developing Hydroid

NANCY C. EDWARDS

University of North Carolina at Charlotte

This report deals with the sequential appearance and localization of major macromolecular species in the marine hydroid, *Hydractinia echinata*. Histochemical analyses were performed during gametogenesis, early embryogenesis, and during the differentiation of the planula larva. In early oocyte growth, increased concentrations of acid protein and RNA were detected. The concentration of RNA, however, decreased in late oocytes as cytoplasmic volume increased. Concentrations of acid protein and neutral mucopolysaccharide materials were observed to be proportional to oocyte age. Cells of the early embryo were only slightly RNA-positive. By the late gastrula stage, the ectodermal cells were markedly RNA-positive, and clearly more so than endodermal cells of comparable stages. Increased staining for RNA was seen in preplanula stages. The presence of acid mucopolysaccharides was observed throughout development without a marked change in concentration. Twenty-four hour planulae showed few differences in staining affinities from early planula stages. The significance of these patterns is discussed in relation to the developmental sequence.

(160)

Purification of the Male Inducing Substance of *Volvox aureus* (M5) and Estimation of Its Molecular WeightTHOMAS H. ELY, *Longwood College*WILLIAM H. DARDEN, JR., *University of Alabama*

The male inducing substance (MIS) of *Volvox aureus* (M5) was obtained in crude form as the filtrate from a static phase culture. The filtrate has been concentrated 100 fold by lyophilization. The redissolved material contains a considerable insoluble residue, which was removed by centrifugation and Milipore filtration. The MIS activity of this solution gave an unexplained increase in activity. The MIS was purified by sequential chromatography on Sephadex G-200, DEAE-Sephadex, and SE-Sephadex. The specific activity of the purified MIS was increased by about one order of magnitude. The concentrated MIS co-eluted from Sagarose Sag-2C with Blue Dextran, a marker with an average particle weight of 2×10^6 . This figure disagrees with an earlier lower estimate determined by ultracentrifugation.

(3)

On the Taxonomic Status of *Sternothaerus depressus* (Reptilia, Testudinata, Kinosternidae)

RONALD E. ESTRIDGE, *Alexander City State Junior College*
ROBERT H. MOUNT, *Auburn University*

A study was conducted to determine the taxonomic and distributional relationships between *Sternothaerus depressus* and *S. minor*. *Sternothaerus minor* is widely distributed in the Southeast. *Sternothaerus depressus* is found in the Black Warrior River system in Alabama from the Fall Line northward, and, with the possible exception of a small area in Tuscaloosa County, its range is allopatric to that of *S. minor*. Two apparently intermediate specimens were collected in Tuscaloosa County, and a seemingly intermediate population occurs in the upper Cahaba River, indicating possible gene exchange in the past between *S. depressus* and *S. minor*. This evidence is insufficient to support a hypothesis of subspecific intergradation, and, until stronger evidence is obtained, it is recommended that *S. depressus* be regarded as a distinct species.

(13)

Derivation of the Fish Fauna of the Big South Fork of the Cumberland River

DAVID A. ETNIER AND CHARLES E. COMISKEY
University of Tennessee

An investigation of the distribution of fishes within the Big South Fork system of the Cumberland River has indicated that about one-fourth of the species currently or recently present in the system have entered from adjacent systems. *Etheostoma sagitta* and *E. kennicotti* have apparently entered the system via stream capture from more easterly Cumberland River tributaries that enter the Cumberland River above Cumberland Falls. *Hybopsis amblops*, *H. dissimilis*, *H. insignis*, *Nocomis effusus*, *Notropis ariommus*, *N. photogenis*, *Pimephales notatus*, *Fundulus catenatus*, *Etheostoma atripinne*, *E. flabellare*, *E. obeyense*, *E. spectabile*, and *Cottus caroliniae* have apparently entered the system from more westerly tributaries to the Cumberland River via a complicated underground drainage associated with a very low divide between Elk Springs Valley and Kennedy Creek, a tributary to the Little South Fork River. Additional species that may have entered the Big South Fork system through the Elk Springs Valley route are *Notropis* sp. (palezone shiner), *N. telescopus*, *Pimephales promelas*, *Lagochila lacera*, *Labidesthes sicculus*, *Etheostoma stigmaeum*, *Percina burtoni*, and *P. macrocephala*. An attempt will be made to deduce the antiquity of these faunal interchanges.

(188)

The Need for Floristic and Vegetation Studies in the Gorges of the Cumberland Plateau

A. MURRAY EVANS AND EDWARD E. C. CLEBSCH
The University of Tennessee

Although the general inventory of the flora of Tennessee is extensive, there is need for critical knowledge in certain areas. One of these is the spectacular system of river gorges on the Cumberland Plateau. Recent preliminary surveys coupled with earlier general collections indicate that there are several taxa endemic here as well as others with peculiar disjunct distributions and further floristic studies are likely to yield additional case studies.

There are also ecological situations wrought by man worthy of intensive systematic study. Within the Obed-Emory and Cumberland River systems there are gorges of similar structure and vegetation. Some have rivers clear and untouched except for sporadic lumbering; others have been destructively lumbered as well as polluted with strip-mine and industrial wastes. Although biosystematic studies of the effects of polluted waters on aquatic and semi-aquatic vascular plants and of the effects of extensive mine tailings on plant populations are few, there is considerable opportunity for such studies here. Mining and lumbering interests pose continual pressures for further encroachments. There is pressure to dam the Cumberland River, and counter pressures for Wild and Scenic River Status for both the Cumberland and the Obed River systems. Any of these current and conflicting proposals for land and river use in the region make prior systematic studies highly appropriate, if not urgent.

(178)

Vascular Flora of Central South Georgia

WAYNE R. FAIRCLOTH, *Valdosta State College*

Central South Georgia is defined as that area of the state lying between the Okefenokee Swamp on the east, the Pelham Solution Escarpment on the west, and extending north from the Florida state line for approximately 100 miles. The 5800 square mile area represents portions of the Upper and Lower Regions of the Atlantic Coastal Plain Province.

The region has not been treated floristically in whole or in part since Harper's classic study of the Altamaha Grit Region, 1906. The vegetation is varied in life-form and extremely diverse floristically. Collections made over a seven year period represent 1645 species distributed in 621 genera and 153 families. At least 1450 taxa are believed to be indigenous and can be arranged into twelve broad vegetation types. Distributional gaps have been filled and ranges extended beyond those previously published. Several new state records have been established.

(112)

Isolation of Recessive Temperature-Sensitive Mutants on the Third Chromosome of *Drosophila melanogaster*

WAYNE L. RICKOLL AND W. DONALD FATTIG
University of Alabama in Birmingham

A technique has been devised for recovering ethylmethane sulfonate-induced temperature-sensitive mutants located on the third chromosome of *Drosophila*. Employing crosses involving the balancer chromosome *TM3, SbSer*, individuals are made homozygous for the EMS-treated Oregon-R third chromosome. A test of the viability of these homozygotes at the permissive (22°C) and restrictive (29°C) temperatures is made. Tested flies which yield offspring at the permissive, but not the restrictive, temperature are scored as temperature-sensitive, and stocks are made and maintained at the permissive temperature.

In addition to their utility in studies of gene action, genetic organization of the chromosome, and developmental biology of *Drosophila*, these conditional lethal mutants provide a method for testing model systems of biological control of insect pests and disease vectors through negative genetic engineering.

(182)

A Biosystematic Study of the Species-group Interiores of *Vernonia* (Compositae)

W. ZACK FAUST, *University of Georgia*

The three taxa (*Vernonia baldwini*, *V. interior*, and *V. missurica*) of the species-group Interiores of the genus *Vernonia* have not been well understood or clearly defined. This study was undertaken to attempt to better define the variation and to clarify relationships within and among these taxa. The variation was studied by using local population samples, herbarium specimens, and transplants. The results of these analyses were compared graphically. Experimental crosses were made with most of the other species of *Vernonia* native to the United States. A number of F₂ and BC progenies were also produced along with the F₁ hybrids. Chromosome pairing at meiosis and pollen stainability were examined in the parents and in the hybrids. Transplant garden studies were undertaken to determine the possible effects of the environment on the phenotype of these plants. Comparative anatomical studies were made of the surface appendages, leaf epidermis, the leaf, and the aerial stem. Flavonoid compounds in the leaves were isolated by paper chromatographic methods to detect inter- and intra-specific differences among the taxa of the species-group Interiores.

(88)

Preliminary Report on the Taxonomy and Distribution of Cavernicolous Bristletails (Insecta: Diplura: Campodeidae) in Virginia

LYNN M. FERGUSON

Virginia Polytechnic Institute and State University

Five species of cavernicolous bristletails of the genus *Plusiocampa* have been described from the United States, one each from West Virginia, Kentucky, and Tennessee and two from Alabama, but nothing has been reported on those present in the extensive cavernous areas of Virginia. During the present study the author has visited over 30 caves, placing bait and/or traps in most of these, in addition to examining material previously collected from 17 Virginia caves. This study has revealed at least four new species of *Plusiocampa* from the caves of southwestern Virginia. The ranges of the Virginia species of cavernicolous bristletails are restricted to caves in the drainage systems of the Powell, Clinch, Holston, and New Rivers, or major parts thereof. They have yet to be collected from caves in the James River drainage basin or in northern Virginia, even though they have been found this far north in West Virginia.

(153)

Toxicity of Mirex to Several Crustaceans

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Toxicity of Mirex to crayfish and several micro-crustaceans was determined from leaching, through feeding, and direct exposure tests in static conditions. Juvenile and adult crayfish, *Procambarus blandingi*, were found to be extremely sensitive to Mirex through direct and indirect exposure. Gas chromatographic analysis of exposed animals revealed an increase in residue with length of exposure. High residues and mortality in crayfish fed Mirex

bait emphasize the potential hazard of biological magnification.

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(86)

The Generic Status of the Eastern North American Isopods of the Family Asellidae

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The eastern North American members of the family Asellidae were formerly thought to be composed of only two genera (*Lirceus* and *Asellus*). Some European workers have recently proposed that the genus *Asellus* be subdivided into two separate genera: *Pseudobaicalasellus* containing only three species from caves in Virginia and West Virginia; and *Conasellus* comprising all of the species of *Asellus* which occur east of the Rocky Mountains other than the few species placed in *Pseudobaicalasellus*. It is the purpose of this paper to reveal the results of recent research into the validity of these newly established genera through use of comparative anatomical and, where feasible, statistical methods.

(43)

The Distribution of the Eggs and Larvae of the Round Herring, *Etruneus teres*, in the Northern Gulf of Mexico

PAUL L. FORE

National Marine Fisheries Service, Beaufort, N.C.

The pelagic eggs and larvae of the round herring, *Etruneus teres*, were identified from 526 plankton samples that were obtained during the 12 monthly cruises of the R/V *Gus III* in 1963. Plankton collections were taken with Gulf-V samplers in oblique tows at 51 stations over the Continental Shelf between Brownsville, Texas, and Mobile, Alabama, by personnel of the National Marine Fisheries Service Biological Laboratory, Galveston, Texas. The distribution of ichthyoplankton revealed that the round herring, a potential commercial species, spawned in the northern Gulf of Mexico from December through the first of March. Most eggs and larvae were taken between the 15- and 60-fathom curves, approximately 54 to 197 km off the coasts of eastern Texas and Louisiana. Although the spawning area was not delineated in a seaward direction, some spawning probably occurred beyond the Continental Shelf. The most abundant clupeid eggs and larvae were those of the Gulf menhaden, *Brevoortia patronus*, which spawned closer inshore from mid-October to March.

(91)

Vallentinia gabriellae (Hydromedusae: Trachymedusae: Olindiadidae), an Easily Cultured Jellyfish

NEAL R. FOSTER

Academy of Natural Sciences of Philadelphia

In March, 1969, the author collected some live cyprinodontid fish eggs in masses of filamentous green algae just south of Progreso, Yucatan. A few weeks after the cyprinodontid fishes had hatched, small medusae were noted in the culture dish. These jellyfish have now been successfully cultured in artificial sea water for more than 22 months on a diet of *Artemia* nauplii. The laboratory

clone apparently descended from a single polyp or frustule inadvertently collected along with the algae.

The medusae attain a relatively large size (bell diameter 6-8 mm). There are four to eight exumbrellar tentacles with terminal adhesive disks in addition to 24-72 hollow marginal tentacles. Polyps are less than a millimeter high and have three to five tentacles. They produce other polyps by frustulation, and medusae by medusae buds. This handsome coelenterate appears to have considerable potential as a laboratory animal for research and teaching. (Supported by Grant G - 15159 from N.S.F.)

(67)

Some Properties of L-lactate Dehydrogenase from *Eimeria stiedae* (Protozoa: Coccidia).

II. Further Studies of the Semi-purified Enzyme

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Auburn, Alabama

The characterization of L-lactate dehydrogenase from *Eimeria stiedae* (EsLDH) is continuing at this laboratory. When specific anion effects were investigated by determining the rate of reduction of pyruvate in acetate, arsenate, benzoate, cacodylate, citrate, histidine, phosphate, phthalate, pyrophosphate, and succinate buffers pH 6.5, ionic strength 0.2, the maximal rate was with citrate, the minimal with benzoate. In regard to the suitability of analogs of NAD as coenzymes, EsLDH resembles the lactate dehydrogenases (LDH's) of mandibulate arthropods more than other LDH's for which data are available, but the present enzyme reduces 3-acetylpyridine NAD at the highest rate reported. Only one isoenzyme is obtained from unsporulated oocysts, and its behavior on electrophoresis suggests that its subunit composition is M_3H . Numerous attempts have failed to produce dissociation of EsLDH and combination of its subunits with those of LDH's from vertebrates.

(121)

Fishes of the Caddo River, West-Central Arkansas

DAVID W. FRUGE, Northeast Louisiana University

The Caddo River, a fast-flowing mountainous river of west-central Arkansas, arises in the Ouachita Mountains west of Black Springs and flows generally in a southeast direction for approximately 68 miles until it junctions with the Ouachita River near Arkadelphia. Several years ago impoundment procedures were started and yet another river was destined for radical alteration. A pre-impoundment survey of the fishes was undertaken during 1969 and 1970. Fishes were collected in areas where flooding had not yet occurred. Sixty-two species, totaling approximately 20,000 specimens were taken in 43 collections. Two endemic species, one as yet undescribed, appear endangered. Significant extensions of known ranges of several species is reported.

(175)

Comparative Biochemistry of Parathion Activation in Two (2) Species of Fishes

JAMES R. GIBSON AND J. LARRY LUDKE

The organic phosphorus (OP) pesticides such as parathion produce toxic effects by inhibiting acetylcholinesterase (AChE). However, there is an apparent lack of

direct correlation between mortality and brain AChE inhibition; and the toxicity of parathion to different species of fishes varies considerably. The activation of parathion to paraoxon, a more potent anticholinesterase, is mediated by microsomal mixed function oxidase (MMFO) enzymes. Several compounds have been described as being antagonistic to this activation, thus altering the toxicity and LC_{50} were examined in an attempt to explain tolerance differences and the lack of correlation between mortality and AChE inhibition in two species of fishes.

(40)

Rain Forest Decapod Crustaceans: II, Osmotic and Ionic Regulation. Class, Crustacea; Order, Decapoda; Family, Palaemonidae, Atyidae, Pseudothelphusidae

CHARLES A. GIFFORD AND TIMOTHY J. COLL
The University of West Florida

The shrimps, *Macrobrachium carcinus*, *Atya lanipes*, *Atya innocuous* and *Xiphocera elongata*, and the semi-terrestrial pseudothelphusid crab, *Epilobocera sinuatifrons* all inhabit the streams of the Luquillo Experimental Forest in Puerto Rico. These streams are very dilute ($Cl^- = 0.02$ to 0.2 mM/L). Exploratory tests of these animals salinity tolerance and blood regulatory ability revealed the following.

Mean osmotic concentrations (in mOsm/L) of blood samples taken immediately after capture ranged from 492 in *M. carcinus* and 478 in *E. sinuatifrons* to 284 in *A. lanipes*. The latter species survived transfer to 100% sea water at a rate of 25%/day. Crabs died one day after completing this transfer, although they showed some ability to regulate blood osmotic and chloride concentrations. Crab urine and stomach fluid remain iso-osmotic to blood under this salinity stress although production of these fluids declines.

Blood copper concentration in the shrimp, *M. carcinus* is much higher than in the blood of most crustaceans (200 ppm vs. 80 ppm), while in the crab, *E. sinuatifrons*, blood Cu is lower (60 ppm) and much more variable. *M. carcinus* apparently has very high concentrations of hemocyanin with high O_2 affinity.

E. sinuatifrons blood differs from that of most other crustaceans in bright yellow or orange. The normal hemocyanin color is absent or masked. The chemical nature and physiological function of this pigment are at present unknown.

(143)

Tunnelling of *Tribolium* Instars, a Photographic Study

EDWARD E. GILBERT, West Georgia College

Two universes, the sectionable vial of Ghent (1966) and the plexiglas chamber of Gilbert (1965, 1969) have been used simultaneously to study motion of *Tribolium* instars. It was found that while one restricted counting to number of beetles (the sectionable vial), the other permitted as well, analysis of tunnels and the distribution of media and the beetles in it.

Patterns of tunnel distribution are not found to be relatable to synchronous distribution patterns of beetles and may reflect behavioral and environmental phenomena. This may, however, be another way of saying that movements of stages or individuals are discontinuous in-

volving *resting* and *moving*, and under different density conditions or in heterogeneous cultures the amounts of time spent resting as opposed to moving changes as a function of density, instar, and species.

The full potential of the Gilbert universe is realized only for short time intervals for as many as four stages of instars. (Supported by National Science Foundation Grant GB6218.)

(131)

Forest Vegetation and Site Relationships in the Mt. Leconte-Greenbrier Cove Area of the Great Smoky Mountains National Park

MICHAEL S. GOLDEN AND H. R. DeSELM

Vegetation, topographic, and soil data from 283 one-fifth acre samples in forest stands of the Mt. LeConte-Greenbrier Cove area of the Great Smoky Mountains National Park were collected in the summers of 1969 and 1970. Sampling elevations ranged from 2260 to 6490 feet, with 93 percent of the samples taken between 2500 and 5000 feet. A total of 174 plant taxa, including 72 woody taxa, occurred in the sample plots. Stand densities ranged from 65 to 475 stems $\geq 5"$ dbh per acre, averaging 166. Stand basal areas varied from 44 to 506 square feet per acre. Above 4000 feet, *Rhododendron maximum* was present in 72 percent of the stands containing hemlock as a dominant. In these stands, *R. maximum* density averaged 1789 stems per acre. No white oak were observed above 2000 feet in the study area. Species importance values were used for relating overstory species to site characteristics.

(212)

Karyotypic Analyses of Cultured Human Leukocytes

RETA HAMILTON, *Austin Peay State University*

Karyotypic analyses of human peripheral blood leukocytes were made in order to identify any numerical or structural anomalies. Prepared slides of cultured leukocytes were photographed and examined for chromosomal abnormalities. Normal karyograms were constructed from phenotypically abnormal patients. Abnormal karyotypes observed include Down's syndrome (Trisomy 21) and cri du chat syndrome (deletion of a portion of the short arm of chromosome 5).

(197)

Fine Structure of Conidiation in *Chloridium chlamydosporis* (Fungi Imperfecti: Hyphomycetes)

TERRENCE M. HAMMILL
SUNY College of Forestry at Syracuse University

Chloridium chlamydosporis produces hyaline conidia from unbranched, erect, darkly pigmented conidiophores terminating in distinct collarettes, and numerous darkly pigmented chlamydospores. Two or three hyaline conidia

may appear to be concurrently produced from within collarettes. Conidiophores may proliferate through collarettes and establish new sporogenous apices at higher levels.

At the apices of conidiophores, an electron-transparent inner wall layer blew out through an electron-dense outer wall layer and into a conidium initial, which after expansion was delimited by a septum. Then a new conidium initial developed below and to one side of the previously delimited conidium and a second conidium was similarly delimited. Thus, hyaline conidia were not produced concurrently from within the collarette, but were produced sequentially in a sympodiosporous fashion. Conidium walls maintained the electron-transparency of the conidiophore inner wall layer. Proliferations developed a new electron-dense wall layer. Fine structure observations showed chlamydospores to be typical aleuriospores.

(115)

Abundance and Diversity of Fish Populations in a Small Stream

HECTOR HARIMA AND PHILLIP R. MUNDY
University of Alabama

Bimonthly collections were made in an unpolluted second order stream just above the Fall Line in Tuscaloosa County, Alabama. Collections were examined to determine the species composition and size variation of members within each species throughout the year. Species diversity indices were calculated to provide a basis for future study of polluted areas adjacent to the study area. Twenty-nine species were collected, of which three cyprinids (*Notropis chrysocephalus*, *N. venustus*, *N. baileyi*) and one centrarchid (*Lepomis cyanellus*) were shown to be permanent residents of the area.

(165)

Ethionine Reversal of Gibberellic Acid Stimulation of Hypocotyl Elongation in *Lactuca sativa* var. Grand Rapids

META S. HARKER, T. W. MERRELL AND B. P. STONE
Austin Peay State University

Ethionine severely inhibited elongation of Grand Rapids lettuce seedling hypocotyls, while addition of methionine to ethionine-treated seedlings resulted in reversal of ethionine-induced inhibition of elongation. Gibberellic acid enhancement of lettuce seedling hypocotyl elongation was nullified in the presence of ethionine. The inhibition of GA enhancement by ethionine was restored by the addition of methionine. Adenosine triphosphate had no effect on hypocotyl elongation and did not reverse the ethionine inhibition. Ethionine inhibited the incorporation of L-leucine-4, 5- H^3 into the seedlings during the 36 to 48 hour time interval of elongation. Leucine incorporation was severely depressed in the GA, ethionine, and methionine treated seedlings. The data suggest that protein synthesis is not required for GA stimulation of hypocotyl elongation in lettuce seedlings. Synthesis and methylation of RNA in seedlings treated with various combinations of GA, ethionine, and methionine will be discussed.

(21)

The Effects of Acute Fast Neutron Radiation on Factors Influencing Drought-Susceptibility of Yellow Poplar (*Liriodendron tulipifera* L.) Seedlings

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Dormant, two-year old seedlings of yellow poplar were irradiated and grown in 100, 50, and 25% of full sunlight to determine how stresses of sublethal ionizing radiation and reduced light might affect tolerance of tree seedlings. Both morphological and physiological responses were measured. Transpiration measurements were made on intact seedlings and excised normal and aberrant foliage. Based on the amount of soil moisture remaining after the plants wilted, the capacity of treated seedlings to extract water was not affected. Rates of water loss, however, were altered. Excised, aberrant foliage transpired at rates per unit area as much as 60% greater than normal foliage. As a response to lateral bud growth following irradiation and shade leaf development, total leaf area increased, thus increasing water requirements. Greater shoot production and decreased root production occurred with increased dose and growth in reduced light, thus decreasing the capacity to supply water. Previously observed increases in drought-susceptibility of radiation-damaged plants are postulated to be a function of increased requirement of tissue for water and decreased capacity to supply water because of altered leaf histology and resultant imbalance of root/shoot ratios following radiation damage to developing buds. (Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.)

(89)

Regenerative Wound Healing in *Corvomeyenia carolinensis* Harrison (Spongillidae)

FREDERICK W. HARRISON, *Presbyterian College*

Regeneration in sponges, as opposed to somatic embryogenesis (the development of an organism from somatic cells), has received little attention. In this study regenerative wound healing was analyzed using a recently developed method for phase contrast observation of living sponges. The outgrowth region of a sponge grown on a cover slip was cut into two separate pieces, both still attached to the cover slip. The wound diameter was approximately sixty microns. The sponge was inverted over a depression slide containing pond water. The wound was observed with phase contrast microscopy. An initial wound bridge is formed by a basal pinacocyte which functionally dedifferentiates to the ameboid condition. The wound bridge enlarges as other cells migrate over the original pinacocyte bridge. Healing is completed within one hour. Archeocytes play a secondary role in the healing process, along with various cell types. Morphogenic patterns in regenerative wound healing in *Corvomeyenia carolinensis* differ significantly from morphogenic patterns reported in sponges engaged in somatic embryogenesis.

(207)

The Stylocyte: A New Poriferan Cell Type

FREDERICK W. HARRISON, *Presbyterian College*

Laboratory-reared specimens of *Corvomeyenia carolinensis* Harrison tied to glass slides from an outgrowth region onto the slide. This region was studied using histochemical techniques and phase contrast microscopy. Explants of *Microciona* sp. were reared in a similar manner in an Instant Ocean (Aquarium Systems, Inc.) refrigerated seawater aquarium for study with phase contrast microscopy.

The stylocyte (Gk. *stylos*-pillar) of *C. carolinensis*, a previously undescribed poriferan cell type, resembles the globoferous cell type found in members of the genus *Microciona*. The stylocyte differs from the globoferous cell type in exhibiting a proteinaceous, non-spicular rod in intimate association with the anucleolate nucleus. Large cytoplasmic inclusions contain glycogen, non-glycogenic PAS—positive carbohydrate, and protein. The stylocyte contains nuclear DNA but no histochemically demonstrable cytoplasmic nucleic acid. The stylocyte type possibly functions in excretion and/or food storage.

(203)

The *in vitro* Initiation of Sporogenous Tissue on Leaves of Cinnamon Fern, *Osmunda cinnamomea* L. (Pteropsida, Osmundales, Osmundaceae)

WILLIAM H. HARVEY AND JAMES D. CAPONETTI
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The growth and differentiation in sterile culture of sporophylls from undifferentiated leaf primordia of cinnamon fern occurred under the influence of various ratios of sucrose and reduced nitrogen. Sporophylls bearing sporangia with viable spores were initiated in a culture medium containing six to eight per cent sucrose and low concentrations of ammonium sulfate. This effect was enhanced by dark maintainance for ten weeks. Additional environmental treatments indicated that high light intensity and long light exposure (Long Day or Continuous light) when coupled with low temperatures inhibited the induction of sporogenous tissue and the initiation of pinna pairs by retarding meristematic activity. Spores produced *in vitro* germinated to produce haploid gametophytes on which sporophytes were produced. Thus it was possible to observe alternation of phase under sterile culture conditions.

(110)

Some Genetic and Physiological Characteristics of Urease-Defective Strains of *Neurospora crassa*

PHILIP HAYSMAN AND H. BRANCH HOWE, JR.
University of Georgia

Fourteen urease-defective mutants were isolated by UV irradiation of wild type 74-OR8-1a conidia, followed by a selective procedure using a phenol red-urea solution. Seven of these mutants were non leaky on medium having urea as sole nitrogen source and showed no urease activity *in vivo* or *in vitro*. Seven others were leaky and showed urease activity *in vivo*, as well as *in vitro* urease activity differing quantitatively from wild type. Three of the non leaky mutants represent alleles of two urease loci previously reported in LG by Kolmark, whereas three others represent two new loci in LG I. The sev-

enth non leaky mutant, either allelic or closely linked to one of the two loci of Kolmark, appeared to have some type of regulatory function; it failed to complement the other six non leaky mutants. The leakiness of the mutants showing urease activity could be nearly eliminated by the use of medium having an equal or excess concentration of nitrogen, as urea, compared to phosphorus.

(201)

Physiological and Morphological Studies of the Genus *Nostoc*. I. Developmental Cycle Variation Among Species

J. S. HENDERSON AND J. T. WYATT
East Tennessee State University

The often-noted irregular physiological activity and general taxonomic uncertainty of some laboratory experimental *Nostoc* strains may be partly due to seemingly erratic developmental-cycle variation. In this study about twenty *Nostoc* strains of diverse habitat and geographical origin have been examined under various cultural conditions. Among the species, strikingly different life-cycle stages persist in apparently identically-treated cultures. Conditions which often induce formation of a new developmental stage in one species (or culture) may not elicit any response in another. The filamentous stage seems to predominate in liquid cultures of most species while the asciolate (cell packet) stage may be more common on solid medium. However, either stage may form the strain's characteristic colony and both forms may exist concurrently in a culture. Eruption of motile hormogones from solid media cultures appear to develop into filaments or asciolate packets, depending upon the species.

(209)

Origin of Fin Elements in the Channel Catfish, *Ictalurus punctatus*

VERNON HENDERSON, *Grambling College*

Embryonic cells of similar anatomical and metabolic behavior give rise to segmented and nonsegmented fin rays. Both kinds of elements in early development display the same histochemical and histological properties. Acid mucopolysaccharides are stainable in both kinds of elements. The cells forming these rays originate from neural crest, sclerotome, and dermatome. The fins with their constituent parts develop into mature structures showing the same anatomical and metabolic properties. The noncalcifiable cells remain as embryonic reserve as seen in regenerating fins. These cells do not incorporate a large amount of tritiated glycine. The failure of these cells to incorporate such indicates that they are not metabolically and physiologically osteoblasts or fibroblasts. Instead, they are mesenchymal cells contributing embryonic reserve to provide for continued growth of the fin.

(37)

An Investigation of the Various Areas of a Reservoir for the Purpose of Determining if Different Eutrophic Levels Occurred Among Them

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Virginia Polytechnic Institute and State University

A study was made on Garza-Little Elm, a reservoir Northwest of Dallas, Texas, for the specific purpose of determining if different areas of the reservoir had different eutrophic levels. The following tests were run on the different areas: phosphates and nitrates, chlorophyll *a*, light and dark bottle oxygen studies and autotrophic and heterotrophic C^{14} uptake studies. The data for each sampling date was subjected to simple analysis of variance tests to determine if differences did occur among the various areas. At the end of the study the data were combined to determine which areas were more eutrophic than others. Bottom sediments were also sampled. Oxygen uptake, Kjeldahl-N, organic-C, and phosphate analyses were run on the sediments. It was found that sediment with high nutrient values had high oxygen uptake values. Those areas of high nutrient concentration and oxygen uptake corresponded well with those areas with the higher eutrophic levels except for the area located in deep water.

(70)

A Comparison of Two Flowing Respirometers for Measuring Fish Oxygen Consumption

W. H. HETTLER, JR. AND D. E. HOSS

Oxygen consumption of a group of pinfish, *Lagodon rhomboides*, swimming in a sealed 200 l circular tank was compared to individual respiration by similar fish in small plastic chambers. The salinity, temperature, flow rate, and percent oxygen saturation of the water flowing through each system was controlled. All fish had been maintained undisturbed and without food in the respirometer for 24 hours prior to the oxygen measurements. Oxygen concentrations were measured polarographically. The oxygen consumed by a group of 128 pinfish (mean weight 7.7 g) was 0.125 mg/g/hr at 29.2 p.p.t. salinity and 14.9 C. Ten pinfish (mean weight 7.5 g), measured individually, respired at an average rate of 0.160 mg/g/hr at 30.8 p.p.t. salinity and 14.5 C. The results suggest that the normal metabolic rate may be nearly the same as the routine metabolic rate for this species and not twice the rate as reported by others.

(60)

Photorespiration and the Occurrence of Leaf Microbodies and Chloroplast Peripheral Reticulum in Grasses Differing in Their CO_2 Fixation Pathways

JOE H. HILLIARD AND S. H. WEST
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Grasses utilize either the Calvin cycle (C_3 plants) or a combination of the Calvin cycle and the C_4 -dicarboxylic acid cycle (C_4 plants) for photosynthetic carbon fixation. C_3 plants exhibit photorespiration, but C_4 plants exhibit little or no photorespiration. Leaf microbodies which contain photorespiratory enzymes are found in both types of plants; however, our studies indicate that those in C_4 plants are fewer, smaller, contain fibrous ele-

ments with globular subunits, and do not contain the crystalloid inclusions often seen in leaf microbodies of C_3 plants. This suggests that the absence of or low rates of photorespiration in C_4 plants is not due to the absence of the necessary organelles. A membranous peripheral reticulum has been reported to occur only in chloroplasts of C_4 plants. We have now seen this structure in a C_3 plant, *Dactylis glomerata* L., selection P3, which has a lower rate of photorespiration than *D. glomerata*, selection A7, which does not have a peripheral reticulum. Peripheral reticulum membranes lack photosystem activity, and they probably serve to facilitate rapid transport of photosynthate from the chloroplasts. This suggests that rapid transport of photosynthate from the chloroplast may reduce photorespiration rates and enhance photosynthetic efficiency.

(68)

Effects of Androgen Treatment on Peripheral Blood

G. R. HOGAN AND A. E. CODY

University of North Carolina at Charlotte

Several hormones have been reported to be effective agents in modifying peripheral red blood cell production and release. The investigations reported here were directed to ascertain the effects of the androgen, testosterone propionate, on both peripheral red blood cell (rbc) and white blood cell (wbc) titers in female mice of the ICR strain. Testosterone injection on each of two subsequent days elicited a marked increase in radio-iron incorporation into rbc; the magnitude of the incorporation was approximately two times that of control radio-iron uptake. In contrast to the increase in rbc production, an abrupt decrease in the wbc titer (wbc/mm³) was observed following testosterone treatment. The time course and dose-response data are reported for testosterone-induced erythropoiesis and leukopoietic depression. Mechanisms of action of the tested androgen creating such effects are postulated. This investigation is supported by a grant from the Foundation of the University of North Carolina at Charlotte.

(172)

Purification and Properties of Bovine Brain Arylamidase

H. W. HOUSE AND D. L. CLAYBROOK

University of South Carolina

Arylamidases which hydrolyze aminoacyl B-naphthylamides have been detected in various organs including brain tissue. Whole, frozen, bovine brain was extracted to yield an enzyme fraction which hydrolyzes arginyl and leucyl B-naphthylamides. Ammonium sulfate, at 45% to 75% saturation, precipitated the crude enzyme. This crude fraction was chromatographed on DEAE cellulose using a linear NaCl gradient of 0.07M to 0.3M which provided additional separation. The crude enzyme has an optimum pH of 6.5 and its activity is stable to freezing but unstable to lyophilization and is inhibited by dithiothreitol. Although the aminoacyl B-naphthylamides are not natural substrates, but enzyme is probably involved in the normal turnover of brain protein and peptides.

(196)

Factors Affecting Dimorphism and Growth of *Histoplasma capsulatum*

WILLIAM E. HOUSTON AND ILDA MCVEIGH

Vanderbilt University

Conversion of *Histoplasma capsulatum* from the mycelial (M) to the yeast (Y) phase was initiated in the absence of an organic sulfur source by maintaining the suspension of mycelial elements used as inocula at 37°C in an environment having a low oxidation-reduction potential (+50 mv or below). For continued growth and maintenance of the yeast cells a suitable organic sulfur source such as lanthionine, cystine, or cysteine was necessary. Abundant yeast growth was evident within 5-6 days of incubation after the pre-treated mycelial inocula were placed in a suitable medium. The reduced environmental conditions were obtained either by incubation of the mycelial suspension in a nitrogen atmosphere or by additions of ascorbic acid to it. Growth of the yeast cells supplied with various organic sulfur sources corresponded with the relative rates of uptake of the sulfur compounds.

(2)

Bioaccumulation of Radionuclides in Turtle Shells (Reptilia: Testudines)

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SKAIDRITE KLEINBERGS, MARGUERITE M. JACKSON

San Diego State College

* Mississippi State College for Women

An analysis was made for the presence of radioactive isotopes in the osseous exoskeleton (shell) of turtle species which are of common occurrence in southeastern United States. Since the turtles were freshly captured from various natural habitats, the radionuclides are presumed to have been incorporated into the shell via the normal food chain route from radioactive fallout. The bony shell material was fired to ash in a muffle furnace, then comminuted to a fine powder for subsequent analysis. Levels of radioactivity were compared to 1) age of animal, 2) diet, 3) type of habitat, and 4) geographic locality.

(109)

The Relationship of Intracellular Energy Levels to Crossing-over in *Neurospora crassa*

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Memphis State University

Wild type *Neurospora crassa*, mating type A, was grown in liquid crossing medium on filter paper cones. Following protoperithecia formation, this culture was fertilized with conidia of the white ascospore mutant, mating type a, and various concentrations of glucose and ATP were added at this time. When the perithecia were mature, they were crushed and the asci scored for normal or recombinant distribution of ascospores. The results show a significant increase in recombination with decreasing levels of glucose and addition of exogenous ATP confirmed these data by significantly lowering the amount of recombination. Thus it appears that there is an inverse relationship between the amount of energy available to the cell at the time of crossing over and the percent of recombination recovered.

(124)
Behavioral and Morphological Evidence
of Monophyly of Nest-building
Cyprinid Fishes

ROBERT E. JENKINS, *Roanoke College*

Relationships of the nest-builders *Semotilus*, *Exoglossum* (including *Parexoglossum*), *Noconis*, and *Camposotoma* have been uncertain. It has been suggested that they independently evolved a nest-building habit. Behavioral evidence that they constitute a monophyletic lineage includes basic similarities in the nest construction process (by males only, transporting stones in the mouth) and zoogeography of nest-building among cyprinids. Morphological similarities are in physiognomy, tuberculation, scales, and vertebral numbers. Non-breeding and nuptial coloration are also indicative of close relationships. Advancements in nest-building (from simple pit-nests to mound-nests) tend to parallel reduction of pharyngeal dentition (2.5-4.2 to 4-4). *Conesius* is most closely related to *Semotilus* and may include a primitive nest-building stock. Fundamental differences among the groups are marked by trophic specializations.

(95)
The Life History of *Pomphorhynchus rocci*
Cordonnier and Ward, 1967 (Acanthocephala)
in the Striped Bass, *Morone saxatilis*

CHARLES A. JOHNSON AND REINARD HARKEMA
North Carolina State University

The life history of *Pomphorhynchus rocci* from the large intestine of the Striped Bass has been studied experimentally and under natural conditions. Eggs were removed from female *P. rocci* and fed to both native and laboratory raised *Gammarus tigris* (amphipoda), juvenile worms were infective after 45 days at 66°F. Infected *G. tigris* were fed to 12 species of non-infected fish, juveniles were recovered from: fingerling *Morone saxatilis*, *M. americanus*, *Fundulus heteroclitus*, *F. diaphanus*, *Etheostoma nigrum*, *Enneacanthus obesus* and *Anguilla rostrata*. Hatchery raised adult Striped Bass were infected by feeding both laboratory infected *F. heteroclitus* and naturally infected *F. diaphanus*.

Many amphipods, isopods, decapods, and insect larvae from Albemarle Sound, North Carolina, were examined for juvenile *P. rocci*, only a few *G. tigris* have been found infected. Of the 27 species of fish from this area examined for *P. rocci*; adult worms were recovered from *Morone saxatilis*, *M. americanus*, *Perca flavescens* and *Micropterus salmoides*; juveniles and degenerate-encysted worms were recovered from *Micropterus salmoides*, *Lepomis gibbosus*, *Leiostomus xanthurus*, *Fundulus diaphanus*, *Aphredoderus sayanus*, *Alosa aestivalis*, *Sciaenops ocellatus*, *Cynoscion nebulosus*, *C. regalis*, *Ictalurus punctatus*, and an unknown species of flounder.

(81)
Distribution of *Liatris*, *Mikania*, *Kuhnia* and
Carphephorus (Eupatorieae — Compositae)
in Virginia

MILES F. JOHNSON, *Virginia Commonwealth University*

Distribution data, recorded in dot maps, have been obtained from observation in the field, herbarium specimens and the literature for *Liatris squarrosa*, *L. scariosa*, *L. turgida*, *L. graminifolia*, *L. spicata*, *Mikania scandens*, *Kuhnia eupatorioides*, *Carphephorus bellidifolius* and *C.*

tomentosus in Virginia. These distributions can, in some instances, be correlated with ecological data concerning soil conditions, elevation, rainfall, etc. This work will be incorporated with other taxonomic research culminating in the publication of the Flora of Virginia.

(181)
Systematic Studies in the Fasciculatae Species
Group of *Vernonia* (Compositae)

SAMUEL B. JONES, *University of Georgia*

Traditionally, the Fasciculatae Vernoniae have consisted of four taxa: *Vernonia fasciculata*, *V. marginata*, *V. corymbosa*, and *V. tenuifolia*. They comprise a group of wide ranging populations, from Ohio to South Dakota and from Texas to Canada, but a morphologically and ecologically allied group of ironweeds. The natural variation within these populations is often increased through inter-specific hybridization. The changes in rank that have been made through the years are indicative of the taxonomic uncertainty that has existed regarding these taxa. Efforts were directed toward an analysis of local population samples and of herbarium specimens and this information was combined with data from comparative leaf anatomy, cytotaxonomy, experimental hybridizations, transplants, and biochemical systematics.

(120)
Comparative Growth of Paradise-fish Fry on
Three Diets (Teleostomi: Perciformes:
Anabantidae)

THOMAS E. JONES AND JOHN D. PIKE, *Knoxville College*

Five-day-old fry of the paradise fish, *Macropodus opercularis* L., from a single brood were separated into three containers. The fry in each container were fed different diets daily. One group was fed an aqueous dispersion of chopped beef liver and heart. The second group was fed a commercially-available, fine grained, 70% protein dry food. The third group was fed freshly hatched live brine shrimp (*Artemia salina*). The total length of fry sampled from each of the three groups was measured at intervals from the sixth to the twenty-seventh day. During this period of development, growth on brine shrimp was far greater than growth on the other two diets. The fry which were fed brine shrimp doubled their length in 12.4 days, while fry of the other two groups did not double their length. When the experiment was terminated, the brine shrimp group had grown to 340% of their original length, while the dry food and the beef groups increased only 118% and 150% respectively.

(214)
A Case of XXXXY/XXXY Klinefelter
Mosaicism in Man

CLYDE KEELER AND LUIS SAMPER
Central State Hospital, Milledgeville, Georgia

A tall, young, mentally retarded, colored male with brain damage has webbed neck, elongated thighs and lateral deviation of wrists and ankles. His hypoplastic breasts bear nipples displaced downward and inward. Marked lumbar lordosis is observed, with android pelvis, miniature testes and sparse pubic hair. Skin tight

and lymphedematous. One notes clonic activity of hands, shoulders and chest; fingers and toes held in partial contraction. Thenar lines are doubled. Complete blood counts and blood chemistries are normal. Bone age is retarded. All molar teeth are tubular. Computer diagnosis is "Klinefelter": 15 supporting and 7 non-supporting from 41 differentiating characteristics listed. Two and three Barr bodies are seen in buccal cells; polymorphs exhibit drumsticks. Equal numbers XXXXY and XXXY spreads are found. X-borne "glucose-6 phosphate dehydrogenase" and "thyroxin binding globulin" levels are normal, suggesting the Lyon hypothesis. Web neck and tight lymphedematous skin characterize Turner and thenarhypothernar atrophy the XYY syndrome.

(173)

A Correlation and Evaluation of Serotonin Kinetics in the Pineal Organ and Intestine of the Rat

T. DANIEL KIMBROUGH
Virginia Commonwealth University

A two-part study has been completed in which certain experimentally-induced changes in brain serotonin levels were correlated with changes in serotonin-induced intestinal motility. The first investigation employed drug treatment of rats in order to selectively deplete brain serotonin. This was followed by taking post-treatment measurements of gut motility. The second part of the study consisted of a fluorometric measurement of pineal serotonin levels following stress by sleep deprivation. The extent of post-stress intestinal activity was indicated through enumeration of fecal droppings at timed intervals. From both phases of this study data was obtained which supports the premise that alterations in serotonin levels of the brain have a pronounced acceleratory effect on peristalsis.

(63)

A Baseline Hematological Determination of Blood Platelets, Leukocytes, and Oxyhemoglobin Levels in the Meadow Vole (*Microtus pennsylvanicus*)

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Richmond, Virginia

This was a preliminary study to note normal aspects and techniques for determining the hematology of the laboratory bred Meadow Vole, *Microtus pennsylvanicus*.

Phase contrast microscopy was used in counting platelets and leukocytes. Oxyhemoglobin was determined spectrophotometrically with the conversion by Ammonium Hydroxide and read from a calibration curve. A terminal tail cropping technique was perfected to provide quantities of blood at repeated intervals without sacrifice of the animal. Ether anesthesia was used to dilate vessels and a 2-0 cotton ligature was placed proximal to the amputation to prevent exsanguination.

Adult males, tested three to four times, provided a mean of 530,000 platelets per mm³. The leukocyte mean for the above animals was 15,080 cells per mm³ with a developing leukocytosis resulting after the first sampling. Oxyhemoglobin had a mean value of 18 mg%.

No animals succumbed or developed diseased conditions other than the leukocytosis. This was attributed as a natural response of the animal to the sampling technique and must be a consideration in further hematology studies requiring the withdrawal of large quantities of blood.

(180)

The Systematics of *Vernonia lindheimeri*

BRUCE L. KING, University of Georgia

Vernonia lindheimeri is restricted to certain calcareous soils of Texas and northern Mexico. Two varieties of this species have been described (var. *lindheimeri* and var. *leucophylla*). On the basis of the comparison of transplants and herbarium specimens the varieties appeared to be quite distinct in certain morphological features. For this reason and since the original descriptions were based on rather limited material, an investigation of the two varieties was undertaken to gain further knowledge of the variation within and between taxa and to clarify their taxonomy. Ecological data, local population samples, and herbarium specimens were analyzed and the results compared graphically. Additional information was obtained from hybridization experiments and cytological observations. The flavonoids of the two taxa were compared using 2-D paper chromatography. In addition, the sesquiterpene lactones were examined by the biochemical systematics group of Dr. T. J. Mabry at the University of Texas.

(24)

Trees as Pollution Indicators I. Loblolly and Aqueous Wastes

JAMES D. KRAFT AND EDWARD E. GILBERT
West Georgia College

The growth rings of Loblolly pines have been utilized to assay the historical recognition of aqueous wastes by trees in the Little Tallapoosa Watershed.

Three cores were taken from each of twenty pairs of trees with similar d.b.h. along the Little Tallapoosa and Buffalo Creek above and below a sewage treatment and a large wire manufacturing plant. One of each pair of trees was selected within prescribed distances of the waterway, while the other, the control, was selected because it was exposed to water only in the form of precipitation. A computer program using a sliding application of the product moment correlation coefficient was devised to cross index trees and to maximize the length (*n*) of subsequences of rings used for comparative purposes. Correlation coefficients with $7 \leq n \leq 11$ are sensitive and practical.

Trees below the wire plant showed a significant decrease in lateral growth over the past decade. (Supported in part by National Science Foundation Grant 7015.)

(135)

The Delineation and Prediction of Forest Cover and Site Parameters by Multiband Remote Sensing

PAUL F. KRUMPEL, Research Assistant
HAL R. DESJELM, Associate Professor
CLIFFORD C. AMUNDSEN, Assistant Professor

This study is part of continuing research to acquire base-line information and techniques to characterize,

predict, and map vegetation and site parameters in the Southern Appalachians. Ground control was achieved using both area and point samples. Multiband spectral reconnaissance was accomplished using a 76 mm quadricamera system containing Ektachrome Aero 2448 and Ektachrome Infrared Aero 8443 each with two lense systems. A key to overstory tree taxa was developed employing Ektachrome color data and 33 crown characteristics. Predictive equations relating imagery data to corresponding field determined crown closure, plot density, crown size classes, and other characteristics have been developed. These relationships as well as those among site and site-vegetation characteristics will be employed in the development of automated scanning techniques for analysis and cover mapping of qualitative and quantitative landscape characteristics.

(142)

A Simulated Natural Habitat for Raccoons (*Procyon lotor*)

CORNELIS LABAN, *Richard Bland College*

Emphasis on the study of behavior of free-ranging animals underlines the notion that much need exists to better understand the social organization of wild animals and, furthermore, that captivity often is a causative factor in altering the behavior of animals. One method of study as used in comparative psychology is to observe, study as used in comparative psychology is to observe, describe and classify behavior of animals according to identifiable functional units of behavior (behavior patterns).

The immediate objective is to present some features of a 50 × 100 foot "Simulated Natural Habitat," where the spontaneous behavior of 63 raccoons was studied over a period of two years. The long-range objectives are to study and compare the levels and distribution of activity between wild-caught and hand-reared raccoons. Information on the raccoon activity will be supplemented by a description of motor behavior elements which in turn is expected to lead to a recognition and understanding of behavior patterns. The behavior patterns will be used to study the adult social organization of raccoons and to construct their ethogram.

(1)

Preliminary Identifications of the Normal Intestinal Bacteria Isolated from One Specimen of *Trionyx spiniferous asper*

MARTHA M. LANDRY AND ANNE L. LAUDERDALE
Mississippi State College for Women

Very few reports are found in the literature describing the intestinal flora of turtles. In these, pathogens as *Salmonella*, *Arizona* and *Citrobacter* species are most frequently mentioned. The present research project was an attempt to describe more completely the microorganisms normally present in the gut of a turtle, and that would grow on ordinary culture media under aerobic conditions. Twenty-two species representing seventeen genera were isolated and identified using a cloacal swab from one large specimen of the Gulf Coast softshell turtle, *Trionyx spiniferous asper*. Since the *Trionyx* is omnivorous, bacterial species commonly found in both plants and animals were observed. From this preliminary investigation, approximately ninety cultures were isolated. Two species were identified from each of the

following genera: *Escherichia*, *Aerobacter*, *Alcaligenes*, *Proteus*, and *Serratia*; and one each from *Achromobacter*, *Arizona*, *Klebsiella*, *Erwinia*, *Flavobacterium*, *Gafkya*, *Paracolonibacterium*, *Protoaminobacter*, *Pseudomonas*, *Sarcina*, *Shigella* and *Streptococcus*. (Supported in part by a MSCW Faculty Research Grant.)

(18)

Certain Effects of Sudden Temperature Increases upon Diatom Populations

GUY R. LANZA AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

Studies were conducted to ascertain effects of sudden temperature increases upon diatoms within their non-lethal temperature range. Populations of *Navicula seminulum* were cultured under controlled laboratory conditions at two ambient temperatures, 18° c and 23° c and then exposed to temperature increases of: (1) 10-12° c above ambient in less than 20 seconds with a return to ambient, or slightly below, in less than 60 seconds; (2) 7° c above ambient with maintenance at this increase for several days; (3) a combination of both (1) and (2). Examination of diatom populations for both immediate and delayed effects of the various temperature increases upon cellular lipids utilizing the 3,4 Benzpyrene-Caffeine fluorescent stain under the ultraviolet microscope did not reveal any detectable alterations. (Research supported by Water Resources Research Grant B017-VA.)

(157)

Malic Acid Dehydrogenase Activity in *Spartina alterniflora*

JULIE LEE AND WILLIAM H. QUEEN
University of South Carolina

Effects of salinity on the activity of malic acid dehydrogenase, a salt sensitive enzyme, in the marsh grass *Spartina alterniflora* has been studied. Preliminary results indicate that malic acid dehydrogenase activity is progressively stimulated by NaCl concentrations up to 0.16 M; higher concentrations reduce activity. Similar results have been obtained with equivalent concentrations of KCl. However, NaNO₃ was found to inhibit activity. The occurrence in halophytes of enzymes adapted to function at relatively high salt concentrations could be a significant factor in the adaptation of these plants to high salinity environments.

(193)

Struvite Formation in Cultures of *Pilimelia terevasa* (Actinoplanaceae)

RICHARD C. LEONARD, *University of Alabama at Huntsville*
A. DOMAS, *University of North Carolina at Chapel Hill*

Struvite (Mg(NH₄)PO₄·6 H₂O) crystals were observed to form in cultures of *P. terevasa* ca. the tenth day of culture in a peptone-Czapek's liquid medium containing concentrations greater than 0.5 g/l K₂HPO₄ and 0.25 g/l MgSO₄. Crystals were not found present in cultures until high concentrations of NH₃ (0.2 mg or greater of NH₃ - N) had accumulated in the medium. Yields of mycelium and struvite obtained from individual flasks indicate that there is no correlation between the amount of struvite formed and the amount of mycelium present. However, there does appear to be some correlation to

the amount of ammonia present in the medium compared to the amount of struvite found to form. Ammonia determinations were lower in flasks with greater struvite yield than in flasks with lesser amounts of struvite. Ammonia is apparently removed from the medium and complexed with phosphate and magnesium ions with the formation of the struvite. By this means, free ammonia is diminished and a certain degree of pH stability is probably maintained.

(12)

Comparative Age and Growth in Two Species of *Percina* (Percidae) in Virginia

GARNETT W. LINK, JR. AND WILLIAM S. WOOLCOTT
University of Richmond

Two closely related species of darters, *Percina notogramma* and *Percina peltata*, occur sympatrically in Virginia. An analysis of the number of annuli and standard length measurements revealed four year classes in both species, with very few individuals surviving to year class III. The growth of both species was approximately the same after the first year; however *P. peltata*, the larger species, apparently gains an advantage during the first year which it never loses. After the third year the rate of increase declines for both. The sexes did not differ significantly in either age or growth.

(7)

Diagnostic Characteristics for Distinguishing *Acris gryllus gryllus* and *Acris crepitans crepitans* (Amphibia, Anura, Hylidae)

RICHARD B. LITTLE, *Auburn University*

All criteria for identifying *Acris gryllus gryllus* (LeConte) and *Acris crepitans crepitans* Baird were evaluated while studying Alabama populations in order to dispel continuing doubt as to their specific status and proper identification. The most reliable characteristics proved to be: 1) extent of webbing along fourth toe [*A. g. gryllus*, 3, but occasionally only 2½, phalanges free; *A. c. crepitans*, approximately 2 phalanges free], 2) snout shape expressed as an index of width at nares divided by length to tip of snout [*A. g. gryllus*, generally < 3; *A. c. crepitans* generally > 3], and 3) distinctive vocalizations clearly distinguishable in the field and as sound spectrograms. Habitat preference, behavior, and general body build are subjectively useful, but size, rugosity and color of dorsum, anal warts, water pH preference, and extension of heel beyond snout were found to be unreliable, at least in part.

(167)

Differential Growth Rates in Experimental Meadow Voles, *Microtus pennsylvanicus*

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The use of the Meadow Vole, *Microtus pennsylvanicus*, as an experimental laboratory animal is very limited and thus this study was undertaken to evaluate the response of this species when exposed to housing conditions commonly provided for experimental rodents.

When differential growth rates of mated males and nonmated males were compared from age 5 weeks to 35 weeks, there was no significant difference in the mean weight gained or the mean animal weight as had been reported for *Meriones unguiculatus* where unmated males had a significant weight advantage.

Adult males, when placed in wire bottom cages were observed to lose a significant amount of weight in the first week and then required 5 weeks to regain the original weight. Not in 27 weeks did the animals in wire bottom cages ever exceed the mean weight of the controls.

Weanling females housed on wire bottom cages from age 4 weeks to age 20 weeks also showed a lower rate of weight gain when compared to the controls.

In general, for experimental purposes, mated and unmated males indicated no significant differences in weight but the use of wire bottom cages appeared unsatisfactory for maintaining adult males or weanling, juvenile and adult females.

(171)

The Toxicological Response of *Dugesia tigrina* to Aflatoxin B₁

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Only a few invertebrates have been exposed to the toxic and carcinogenic effects of aflatoxin B₁. Large quantities of brown planaria, *Dugesia tigrina*, were exposed for periods up to three weeks to a pure form of this fungal metabolite dissolved in sterile, distilled water. The concentration levels ranged from 0.061 ug/ml to 12.5 ug/ml. Whole animals and regenerating heads and tails were included in the study.

These studies were intended to be a preliminary evaluation of the sensitivity of *Dugesia tigrina* to aflatoxin B₁ as well as determining the potential of the animal as a biological test organism.

Dugesia tigrina appeared to be more sensitive to the toxin than brine shrimp, *Artemia salina*, which were reported to have a 90% mortality level at 1.0 ug/ml and above.

Experiments completed at this time indicate 100% mortality level in both whole and cut brown planaria at a concentration of 0.625 ug/ml and above. No deaths occurred in the whole, control animals and only minimal losses occurred in the cut, control animals.

Studies are underway that will determine the effects of lower concentrations of aflatoxin on both the whole and regenerating brown planaria.

(41)

Preliminary Studies of the Effects of Simulated Heated Discharges from Power Generating Stations on Protozoan Communities

GENE LORTON
Virginia Polytechnic Institute and State University

Water was pumped from a 1200 liter reservoir with natural photoperiod and seasonal temperature fluctuations (7-16°C) through a copper coil in a hot water bath with a temperature increase of 20°C in 10 seconds to simulate passage through the condenser of a thermoelectric power plant. Water was cooled to ambient reservoir temperature in a cold water bath in 12 seconds. This water then passed through three Plexiglass troughs

79cm × 5cm × 3.5cm deep. Two identical troughs supplied with unheated reservoir water served as controls. Flow rate was 300 ml/min/trough. Each trough was sampled weekly for six weeks. The number of observed protozoan species/trough ranged from 10 to 28. No significant differences in diversity of species between control and experimental communities were observed; however, differences between control and experimental communities in numbers of individuals/species (suggesting complex differences in community composition), were observed. (This work was supported by the Office of Water Resources Research Grant B-017-VA and the Federal Water Quality Administration grant WP-166.)

(158)

Salinity as a Plant Distribution Effector: Photosynthesis and Respiration in *Spartina alterniflora*

PAUL T. LUCE AND WILLIAM H. QUEEN
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Salinity as a factor affecting vertical distribution of *Spartina alterniflora* in Atlantic coast salt marshes through its effects on photosynthesis and respiration was investigated. Plants growing in marsh mud in the greenhouse were subjected to root inundation with artificial sea water of differing salinities in accordance with natural tidal cycles. After four weeks of treatment at salinities of 0, 18, 36, and 54 ppt, photosynthetic rates (gross) were found to be 15.7, 17.9, 12.5, and 8.4 mg CO₂/hr/dm², respiration rates were 2.1, 2.1, 2.5, and 2.4 mg CO₂/hr/dm² with the ratios between the two processes being 8.5, 9.5, 6.0, and 4.5 respectively. These ratios, which are indicative of the amount of food available for growth, suggest that *Spartina alterniflora* is best adapted to exist in moderately saline environments. However, its occurrence at higher salinities is restricted because of its inability to produce adequate quantities of excess photosynthate.

(174)

In vivo Activity of Microsomal Mixed Function Oxidases (MMFO) in Freshwater Fishes

J. LARRY LUDKE AND JAMES R. GIBSON

Microsomal mixed function oxidase (MMFO) activity as evidenced by aldrin epoxidation and parathion activation was demonstrated in livers of four species of freshwater fishes. Aldrin epoxidation was inhibited by as much as 85% following pretreatment with sesamex, a competitive inhibitor. Pretreatment of mosquitofish, *Gambusia affinis*, in 2ppm sesamex antagonized parathion poisoning by approximately 20-fold by inhibiting the activation of parathion to paraoxon. SKF-525A also antagonized parathion toxicity. The optimum time and concentration for pretreatment of mosquitofish was about 42 hours at 1 and 2 ppm.

(198)

Light Intensity and Size of Conidia in *Bipolaris* spp.

E. S. LUTTRELL, *University of Georgia*

Seven species of Fungi Imperfecti in the genus *Bipolaris* (= *Helminthosporium* p.p.) were grown on V-8 juice agar in darkness and under continuous light from cool-white fluorescent tubes at intensities of 6, 12, 25,

50, 100, 200, 400, 800, and 1600 ft. c. Conidia developed in light were consistently longer. The patterns of response varied among the species, with *B. sorokiniana* and *B. rostrata* representing the extremes. Mean lengths of conidia in *B. sorokiniana* were 73μ in darkness and 85μ at 6 ft. c. with little further response. Conidium length in *B. rostrata* increased with increasing light intensity to a maximum at 200-400 ft. c. Conidia produced in darkness were 70-160μ (mean 101μ) long. Those produced at 400 ft. c. were 170-310μ (mean 235μ) long, exceeding the dimensions of an undoubtedly synonymous species described as *Helminthosporium longirostratum*.

(62)

Daily Variations of the Oviducal Responses in the House Sparrow, *Passer domesticus*

ROBERT MACGREGOR, III AND ALBERT H. MEIER
Louisiana State University

The magnitude of response of the oviducal weight to injections of estradiol varies with the time of day when the injections are made. Daily injections (10 μg/injection) at the end of a 16-hour photoperiod were more effective (p. < 01) in stimulating gains in oviducal weights (55 mg.) than injections given at the onset of the photoperiod (24.8 mg.). In another experiment, estradiol (10μg/injection) caused weight gains as high as 358 mg. at one time of the day and as low as 51 mg. at another. The weights of saline injected controls averaged 27 mg. Our results indicate that the time of day when estradiol is present may have an important role in reproductive physiology.

(47)

Radiotracer Analysis of Feeding by Soil Invertebrates¹

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National Laboratory²*

Intact soil microcosms provided with a ¹³⁷Cs-tagged litter layer permitted study of a decomposer food web with minimal disturbance to community structure. Trophic level associations were determined using the transient behavior of the radionuclide along food chains and feeding rates were estimated from radiocesium mass balance equations. Fungivores constituted ca. 60% of the mesofaunal biomass and included larval Scatopsidae (Diptera); Enchytraeidae (Annelida); Entomobryidae and Onychiuridae (Collembola); Rhodacaridae (Acarina; Gamasina); and Oribatulidae, Camasiidae, Carabodidae, and Cymbaeremidae (Acarina; Oribatei). Ingestion averaged 7.05 ± 2.41 percent dry body weight per day for all fungivores. Cecidomyiidae larvae (Diptera), Isotomidae (Collembola), Phthiracaridae (Oribatei), uropodine mites and millipedes fed on surface litter at the rate of 1.02 ± 0.36 percent dry body weight per day. Predators included Dolichopodidae larvae (Diptera) and gamasine and prostigmatid mites. Predators averaged 2.46 ± 0.96 percent dry body weight ingested per day.

¹ Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

² Permanent Address: Graduate Program in Ecology, University of Tennessee.

(20)

A Taxonomic Revision of Granite Outcrop Species of *Arenaria* (*Minuartia*)

J. FRANK McCORMICK, *University of North Carolina*
JOHN R. BOZEMAN, *Georgia Southern College*
STEPHEN SPONGBERG, *Harvard University*

A previously unreported species is discussed. *Minuartia glabra* (Michx.) Mattfeld and *Minuartia uniflora* (Walt.) Mattfeld are proposed as the proper taxonomic treatments of *Arenaria glabra* [*A. groenlandica* var. *glabra* (Michx.) Fern.] and *Arenaria uniflora* (Walt.) Muhl. respectively. The new species and *M. uniflora* are more closely related to one another than either is to *M. glabra*. *M. glabra* is postulated to be derived from the Arcto-Tertiary flora which invaded the Piedmont from the Appalachian Highlands. The new species and *M. uniflora* are thought to be products of the Madro-Tertiary flora which invaded the Piedmont from the Southwestern United States and Mexican Highlands.

(104)

A New Hemoglobin Variant in the Deermouse (*Peromyscus maniculatus* — Mammalia: Rodentia: Cricetidae)

KATHERINE M. McCracken
University of South Carolina
AND CHARLES W. FOREMAN, *University of the South*

A new electrophoretic hemoglobin variant has been detected in the deermouse, *Peromyscus maniculatus*. This variant, which initially appeared in a single individual captured near Flagstaff, Arizona, is the third electrophoretic variant reported in this species. This hemoglobin migrates more anodically during vertical polyacrilimide gel electrophoresis than the two other hemoglobin types identified in *P. maniculatus*. Genetic analysis of this variant indicates it is autosomally inherited by alleles at a single locus.

(6)

Dentitional Morphology in Desmognathine Salamanders (Amphibia: Plethodontidae)

D. BRUCE MEANS
Florida State University

The gross morphology of mandibular and maxillary teeth was examined with an electron scanning microscope for species in the genera *Desmognathus*, *Leurognathus* and *Phacognathus*. All forms were found to have pedicellate, bicuspid teeth. The teeth of most species have conically shaped crowns whose apices are located distally to their bases of attachment to the pedicel. The lingual cusp is usually the largest and forms a piercing blade; often it is directed posteriorly, giving the crown a recurved shape. *Desmognathus brimleyorum* Stejneger is considered a valid species on the basis of tooth morphology. It is the only desmognathine which has a fungiform crown consisting of two equally flattened cusps with a shallow trough between them. The question is raised whether these are functionally molariform teeth.

(99)

Acute Zinc Toxicity to *Schistosoma mansoni* (Trematoda, Strigeatoidea, Schistosomatidae) Cercariae in a Chemically Defined Water Medium

JOHN A. MECHAM AND R. B. HOLLIMAN
Virginia Polytechnic Institute and State University

Time until death studies were run on *Schistosoma mansoni* cercariae in 15 concentrations of zinc ranging from 57.6 ppm to 1 ppb. A chemically defined water medium was used for the dilution and control medium, and a partially enclosed slide chamber was used for the close observation of test cercariae. In concentrations less than 57.6 ppm, zinc was found to have little lethal effects on cercariae during that period of time in which the cercariae were most likely to be infective (0-6 hours). Zinc concentrations of 1 ppb were found to kill all test cercariae within 46 hours at 21-22°C. At the highest concentration tested, 57.6 ppm, zinc was found to immobilize all test cercariae within 6 hours at 21-22°C. The average time until 100% mortality for the control cercariae was 49 hours.

(166)

The Effects of Temperature on the Rate of Gas Secretion and the Composition of Gases in the Swimbladder of the Bluegill Sunfish, *Lepomis macrochirus*, (Osteichthyes, Perciformes, Centrarchidae)

JOHN A. MECHAM AND ROGER McNABB
Virginia Polytechnic Institute and State U.

Fish were acclimated at 12, 22, and 32°C. Swimbladder volumes were determined using a pressure chamber designed to measure a change in volume with a change in pressure. One half of the swimbladder gas was removed with a syringe and volume measurements were redetermined at 8, 16, and 24 hours after partial deflation. Swimbladder gases were analyzed for oxygen, carbon dioxide, and nitrogen at 0 and 24 hours. The rate of total gas secretion (0-24 hours) was significantly slower at 12°C than at 22°C or 32°C with no significant difference between 22°C and 32°C. However, maximal rates of gas secretion (0-8 hours) were found to be independent of temperatures tested. Oxygen was found to contribute most extensively to filling at high temperatures and carbon dioxide secretion was found to be accelerated at lower temperatures.

(71)

Circadian Basis of the Hormonal Control of Fattening in the White-Throated Sparrow, *Zonotrichia albicollis*

ALBERT H. MEIER AND DONN D. MARTIN
Louisiana State University

Studies in our laboratory have demonstrated that either corticosterone or prolactin elicit fattening in the White-throated Sparrow when each hormone is injected at specific times of day suggesting that a temporal synergism of corticosterone and prolactin regulates the level of fat stores. To test this hypothesis, daily prolactin injections (s.c.) were made at 6 specific times relative to corticosterone. High levels of fat stores resulted from pro-

lactin injections given for 5 days at 4 or 12 hours after corticosterone. However, prolactin injections given 8 or 20 hours after corticosterone reduce the levels of body fat. Intermediate levels of lipids were obtained when prolactin was given 0 or 16 hours after corticosterone. Our results suggest that seasonal fluctuations in body fat levels are the result of changing relations of the daily rhythm of corticosterone and prolactin.

(80)

The Contribution of Rafinesque to the Early Botanical Exploration of Kentucky

WILLEM MEIJER, *University of Kentucky*

The interpretation of Rafinesque's new names for genera and species of North America plants has to be based for a great part on an intense study of local floras of Louisiana, Kentucky, and Pennsylvania. This task, essential for a thorough historical-bibliographic background for a Flora of North America is by no means finished, though the results may be mainly of historical value. It will show the opportunities and limitations of a botanist working in a frontier situation without sufficient communications with earlier centres of taxonomic research, enormously motivated by a strong scientific interest in his surroundings, in many respects far ahead of his time, a great naturalist but not in a good position to coordinate his own work with that of others.

(118)

A Survey of the Fishes of the Choctawhatchee Bay Drainage in Alabama and Florida

MAURICE F. METTEE, JR., *University of Alabama*

A survey of the fishes inhabiting the freshwaters emptying into Choctawhatchee Bay was made between October, 1967 and April, 1969. One hundred and forty-six collections made at one hundred and two stations in Alabama and Florida plus literature records revealed the fish fauna of the Choctawhatchee to be composed of thirty-four families, one hundred and twelve species and five subspecies. Of the one hundred and seventeen species and subspecies, eighty are freshwater and thirty-seven are euryhaline. *Etheostoma okaloosae*, the only endemic species collected, is recorded for the first time as occurring sympatrically with *Etheostoma edwini*. Four additional species, *Notropis cunummingsae*, *Lepomis auritus*, *Elassoma okefenokee* and *Alosa chrysochloris*, represent extensions of previously known ranges.

(96)

The Life Cycle of *Pharyngostomoides procyonis* (Trematoda: Strigeoidea). Studies on the Second Intermediate Host

GROVER C. MILLER AND REINARD HARKEMA
North Carolina State University

The life cycle of *P. procyonis* is yet incomplete but work in recent years has contributed important information on various facets of the cycle. Additional observations confirm our earlier report on the maternal transmission which appears to be the first such report for a trematode parasite. The feeding of certain branchiobdellid annelids containing mesocercariae to raccoons established infections of *P. procyonis*. This is still another unique aspect in trematode life cycles for this is apparently the first report of annelids serving as second inter-

mediate hosts for trematodes. Nearly 700 cray fishes were examined and 9921 annelids were recovered. Approximately 15% of the annelids were infected with either 8703 small mesocercariae or 489 large mesocercariae. We believe these two sizes represent the two species in the genus *Pharyngostomoides*. The description of the adult of the second species is in press. In experimental feedings both mice and kittens were negative but raccoons, collected from Smith Island, North Carolina and determined to be negative for this parasite, were infected on three different occasions. The only gap remaining in the life cycle is from the snail to the annelid. This is presently being studied.

(164)

Induction of a Light Requirement for Germination in *Lactuca sativa* Lettuce Seeds

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Austin Peay State University

The exposure of dark germinating New York lettuce seeds to continuous far-red light for 24 hours results in the induction of photosensitivity. The germination response of the 24 hour far-red treated seeds to repeated red or far-red light regimes is similar to the classical photosensitivity of Grand Rapids lettuce seeds. Induction of photosensitivity does not occur in New York lettuce seeds soaking in the presence of chloramphenicol during the 24 hour far-red light exposure. Actinomycin-D at low concentrations prevents the induction of photosensitivity, whereas induction occurs at higher concentrations. 5-Bromouracil, 5-fluorouracil, 2-thiouracil, ethionine, and cycloheximide do not prevent the induction of photosensitivity.

(11)

Life History Aspects of the Tripletail, *Lobotes surinamensis* (Chordata: Pisces: Lobotidae), in Temperate Waters

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Data from 14 tripletails captured in North Carolina 1969-1970 are presented. Length-weight equations were $\text{Log}_{10} \text{ weight} = -4.0462 + 2.8785 \text{ Log}_{10} \text{ SL}$ and $\text{Log}_{10} \text{ weight} = -4.3566 + 2.8967 \text{ log}_{10} \text{ TL}$. No differences were observed between sexes. Scale readings indicated probable winter annulus formation and rapid growth. The largest fish measured was 18½ pounds (8399 gm). The oldest fish was 3+. Gonad condition showed early summer spawning with males ripe-running in July and August. Females were spent in August. Strong piscivorous habits were shown with clupeids dominating food items. Shrimp, squid, and blue crab were also present. *Lobotes* is considered a migrant species into North Carolina waters though some may overwinter in the inshore waters. Data presented will hopefully arouse interest in the life history of this little known species throughout its range.

(65)

The Effect of DDT and Dieldrin on Succinic Dehydrogenase Activity in *Gambusia affinis*

GLADYS MOFFETT AND JAMES D. YARBROUGH
Mississippi State University

Comparisons of succinic dehydrogenase activity of liver and brain mitochondrial preparations from DDT and dieldrin resistant and susceptible mosquitofish demonstrate insecticide inhibition in susceptible tissues and stimulation in resistant tissues. When the mitochondria are disrupted by repeated freezing and thawing there is inhibition of enzyme activity by both insecticides in resistant liver and susceptible brain and liver preparations. In resistant brain mitochondria dieldrin stimulates enzyme activity in both intact and ruptured treatments.

(51)

NADH and NADPH Diaphorases in *Euglena gracilis* var. *bacillaris*

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In attempts to spectrophotometrically demonstrate NADPH linked malate dehydrogenase considerable difficulty was encountered mainly because endogenously NADPH was oxidized. Further experimentations demonstrated the presence of a NADPH linked diaphorase system. The results to be discussed in this report imply the presence of NADPH and NADH diaphorase in *Euglena gracilis* var. *bacillaris*. The reported findings are the results of electrophoretic and spectrophotometric assays. Partial purification and characterization of the enzyme are in process. (Supported in part by the Atlanta University Center Research Committee and the Research Corporation — Brown Hazen Fund.)

(17)

Relict Cranberry Glades in North Carolina

J. KENNETH MOORE, *University of North Carolina*

Long Hope Valley is an isolated valley lying north-south in Watauga and Ashe Counties of North Carolina. The floor of the valley at 4000 feet elevation is significantly higher than valleys of the surrounding mountainous terrain. Within a forest of Red Spruce, *Picea rubens* Sarg., which dominates the sides of the creek flowing north out of the valley, are four cranberry glades. Additional glades are situated outside the wooded area where land was cleared for pasture. Of botanical significance are: 1) Red Spruce occurring in North Carolina in abundance at 4000 feet; 2) abundance of typically northern species which are of rare occurrence in North Carolina; 3) presence of at least two species and three genera never before reported as far south as North Carolina. The glades and associated northern species are evidence that Long Hope Valley continues to support vegetation more typical for the area during the last glacial age.

(38)

A Time until Death Study of Bluegill Sunfish (*Lepomis macrochirus* Raf.) Exposed to Simultaneous Thermal and Zinc Stress

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AND JOHN CAIRNS, JR.

Virginia Polytechnic Institute and State University

This study was initiated to gain base line information on the response of the bluegill sunfish exposed simultaneously to two forms of pollutional stress: (1) zinc and (2) heat. Bluegills were exposed to five temperature regimes at 5.6 and 10.0 ppm Zn⁺⁺ (calculated as Zn⁺⁺ from ZnSO₄ · 7H₂O). Both concentrations of zinc were tested on 10 fish which had been acclimated to 20°C, and 30°C, and fish which were acclimated to 20°C but were exposed to a maximum temperature of 30°C increased at the following rates: 1° C/24 hr., 1° C/1 hr., and 1.5° C/10 min. Time until death observations were made hourly for 120 hours.

These data show that some mortality occurred in only two of the five temperature regimes tested at 5.6 ppm Zn⁺⁺. For fish exposed to 5.6 ppm Zn⁺⁺, deaths were recorded for 30° C acclimated fish, and fish acclimated to 20° C but exposed to 30° C at a rate of temperature increase of 1.5° C/10 min. At 10.0 ppm Zn⁺⁺ some mortality occurred at all five test temperatures. Deaths increased at 10.0 ppm Zn⁺⁺ as the rate at which thermal stress was applied increased. (This study was supported by funds from FMC Corporation.)

(162)

Physical Factors in Conidial Germination of *Erysiphe cichoracearum*

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The effect of light on fungal sporulation and germination is complex. Both the nature of the response and the stage of development at which the fungus is light-sensitive vary with the quality and intensity of the light, the duration of exposure and other environmental factors. A study of the influence of several factors in the physical environment on the germination of conidiospores of the powdery mildew *Erysiphe cichoracearum* has revealed the following information. The longevity of conidia can be measured by hours, and that pretreatment of infected host plant organs to remove nonviable conidia can improve germination percentages. Light was found to stimulate conidial germination at a temperature of 14°C. The highest percentages of conidial germination were obtained at 18° to 24°C. There was little germination or infection below 10° and none at 32°C. Free water on leaf disk surfaces inhibited germination, while high relative humidities favored higher percentages of spore germination. *In situ* germination of conidia was observed in leaf disk culture.

(177)

Normal Blood Glucose and Liver Glycogen Levels in C3H and Dublin ICR Mice

ANDREW W. MOSLEY, *Memphis State University*

Normal Blood Glucose and Liver Glycogen levels were compared in C3H and Dublin ICR mice. Male and female mice of each strain were compared separately and determinations were made weekly from 1 to 4 weeks of age. Males of each strain exhibited similar initial blood

glucose levels higher than that of the females, but final blood glucose levels in males of each strain were lower than those observed for females. Overall blood glucose levels were higher in C3H mice. Liver glycogen levels were higher in Dublin ICR females than in males of either strain of 4 weeks of age, with Dublin ICR mice showing the most significant increase in liver glycogen over a 4 week period. Other aspects of carbohydrate metabolism are presently being considered and these will be used to determine how infection with Moloney Leukemia Virus may alter carbohydrates metabolism in these mice.

(194)

Morphogenetic Studies of the Moss, *Tortula pagorum*

SUSAN M. MOYLE, *The University of Tennessee*

An attempt was made to determine the optimal conditions for the "normal" morphogenesis of *Tortula pagorum* in sterile culture. To this end, the asexual reproductive cycle of the moss, from gemma to gemma, is described under varying conditions of light, temperature, and substrate. These observations might help one understand why this species is relatively abundant in cities.

Gemmae placed on mineral media and grown under continuous light at 20°C developed into gemmae-bearing rosettes after about two months. Dissection of these rosettes revealed a previously unreported structural feature evidently characteristic of the species: the upper portion of the stem is actually a compact bundle of gemmae-bearing stem branchlets. Several different growth-forms of the rosette, corresponding to those found in natural collections, may be obtained by varying light quality and quantity. Protonemata as well as rosettes show a markedly different growth-form under incandescent light as opposed to fluorescent light. The incandescent light effect may be duplicated under red light. The abundance of the moss in cities, where shorter wavelengths are relatively reduced by smog and where chemical stresses may be excessive, appears to be correlated with this species' ability to complete its asexual reproductive cycle in culture under red light and with its tolerance to certain chemical stresses in the medium.

(113)

Isolation of Recessive Temperature-Sensitive Mutants on the First Chromosome (X) of *Drosophila melanogaster*

DAIL W. MULLINS, JR. AND W. DONALD FATTIG
University of Alabama in Birmingham

A procedure has been developed for isolating ethyl-methane sulfonate-induced temperature-sensitive mutants on the *Drosophila* first chromosome. Treated Ore-R males are crossed to attached-X females and the progeny from this cross are mated in a pairwise fashion. Each female is allowed to lay eggs at the permissive temperature (22°C) for three days, then transferred to a fresh vial and allowed to lay eggs at the restrictive temperature (29°C). Tested flies which yield male progeny at the permissive, but not the restrictive, temperature are scored as temperature-sensitive lethals. Two mutants have been observed which are not lethal at the restrictive temperature, but which instead exhibit an altered phenotype. These are considered to be temperature-sensitive visible

mutants. Should it be possible to isolate a temperature-sensitive allele of a gene affecting a known enzyme, a unique system would exist for the study of structure-function relationships in the proteins of higher organisms.

(187)

Anatomy of the Haustoria of the Genus *Aureolaria* Raf. (Scrophulariaceae)

LYTTON J. MUSSELMAN, *University of North Carolina*

Haustoria of *Aureolaria* consist of three distinct tissue regions as seen in transverse section: cortex, vascular core, and central parenchymatous core. The cortex is several cell layers thick and in perennial species contains brachysclereids. The vascular core extends ventrally from the stele and consists of irregularly shaped tracheary elements with scalariform pitting. The central parenchymatous core extends from the vascular core to the tissues of the host root. Traversing the central parenchymatous core are strands of short vessel elements which connect the vascular tissue of the haustorium with that of the host.

(27)

Dry-matter Production in Young Loblolly (*Pinus taeda*) and Slash (*Pinus elliottii*) Pine Plantations: Estimation of Root Biomass

JOHN CHARLES NEMETH, *North Carolina State University*

Standing crop of root biomass in young plantations of loblolly and slash pine in the vicinity of Aurora, North Carolina was estimated. Two forms of the harvest method were employed: 1. excavation of roots greater than 0.5 cm in diameter and 2. sample corings of roots less than 0.5 cm in diameter. Regression relationships between above ground tree dimensions and root biomass (> 0.5 cm) were investigated. The r^2 values all exceeded 0.9 and indicate good prediction of root weight given adequate sample size. Estimations are reported in metric tons per hectare.

(29)

A Limnological Survey of Mountain Lake, Giles County, Virginia

E. K. OBENG-ASAMOA AND B. C. PARKER
Virginia Polytechnic Institute and State University

Mountain Lake is the only natural lake in Virginia and was formed by a rockslide dam of a mountain stream. Situated at an altitude of 1200 meters it towers nearly 305 meters above the surrounding ridge tops. It is fed entirely by springs and has no significant outflow. The water is slightly acidic and very poor in dissolved nitrogen, phosphorous, and iron salts.

Primary productivity studies using chlorophyll analysis, oxygen evolution, and $C -^{14}$ uptake methods, as well as cell counts and sediment studies, indicate the lake is oligotrophic but slightly less so than previously reported. The present phytoplankton community consists chiefly of desmids except in late fall through the winter when the diatom, *Cyclotella comta* dominates to the exclusion of desmids. *Sphaerocystis Schroeteri* and *Planktosphaeria gelatinosa* occur throughout the year.

(82)

Chemosystematic Studies of Sporophytes of Native *Lycopodium* Utilizing Polyacrylamide Gel Electrophoresis

JERRY C. ODENWELDER, *University of Tennessee*

Most electrophoretic studies in the past have used pollen, spores, fruit, and gametophytes, but few have used adult sporophytic tissue. The problems associated with vegetative material stems from varying seasonal changes and from developing a technique for a particular genus.

In this study sporophytes of six species of *Lycopodium* are being used for comparisons of protein band separation. The extraction method being used consists of Cleland's reagent, Hepes buffer, Polyclar AT, Sephadex, and dialysis in .01 M Tris-Glycine. Protein determinations are being accomplished by the Lowery method, with 200 microgram samples applied to a 7% acrylamide gel catalyzed with ammonium persulfate. The gels are exposed to 3ma/tube current for one hour, removed and placed in 50% TCA for 24 hours, and stained with .25% Coomassie Blue in 20% TCA for one hour. Destaining of the gels is accomplished by submersion in 7% acetic acid for three days. Afterwards, the gels are photometrically recorded and R_p values determined for analysis.

(94)

Observations on the Collection and Maintenance in the Laboratory of the Land Planarian, *Bipalium kewense*

DONALD A. OLEWINE AND RANDALL L. MORTON
Georgia Southern College

The land planarian, *Bipalium kewense*, has not been extensively used in either teaching or research. The literature reports on this group are relatively few and are usually concerned with small numbers of animals. This paper is concerned with the availability of specimens, collection techniques, and the maintenance of land planarians in the laboratory. These are all important in the utilization of this unique species for experimental purposes. In a three month period we have collected over 200 land planarians from an area 64 feet $\times$ 48 feet. By examining specific sites in this area once a day 77 planarians were collected during December and grouped according to body size: 2 very large, 26 large, 35 medium, 10 small, and 4 segments. The larger intact animals weighed in the range of 1,400 mg. while the segments varied from 110-340 mg. Soil from the three collecting sites have been analyzed for moisture content, organic content, acidity, and soil texture at the surface and at the following three levels below the surface: 4-5 inches, 8-10 inches, and 17-20 inches.

(9)

Effects of Gradient on the Distribution of Fishes in Western North Carolina (Osteichthyes)

L. M. OUTTEN, *Mars Hill College*

During the period from September, 1949, through November, 1970, more than three hundred field studies were conducted in western North Carolina and other areas. In Ivy Creek, a tributary of the French Broad River, upper Tennessee River system, collections of fishes were obtained from locations at the upper-headwater-stream sources, in the multifold tributaries, through the central area, and down to the lower regions. Determinations of

the identity and abundance for the fishes represented at each locality, correlated with the elevation and gradient, provided valuable and meaningful information concerning the distribution of fishes in Ivy Creek, a typical stream of western North Carolina.

(199)

Studies of the Chemical Composition of Myxomycete Peridia

BRUCE C. PARKER

Virginia Polytechnic Institute and State University

Cytochemical, analytical chemical, and ultrastructural studies indicate that the peridia of a number of myxomycetous fungi possess protein as a major structural component. The significance of these components to systematics and phylogeny is discussed.

(213)

Postnatal Bone Development in Mongolian Gerbil *Meriones unguiculatus* (Mammalia, Rodentia)

DENISE I. PAV AND RANDALL W. MCKEE
East Tennessee State University

Postnatal development of long bones was studied in the Mongolian gerbil (*Meriones unguiculatus*) and the results are presented in this paper. A total of sixty six animals, ranging from newborn to eight months of age, was used in this study. Findings were deduced from radiograms and histological examination of decalcified bone.

Gerbils possess a persistent epiphyseal plate in adulthood. Longitudinal growth of femurs is greatest in the periods between birth and sexual maturity, slows down in adulthood and decelerates markedly in old age.

(132)

Effects of DMSO and Fertilizer on the Growth of *Zea mays* and *Nicotiana tabacum*

ROBERT A. PEDIGO, *St. Andrews Presbyterian College*

Commercial varieties of corn and tobacco supplied by the McNair Seed Company were germinated and started in growth chambers and later moved to the green house. After selection for uniformity of size the plants were exposed to a 3 $\times$ 4 factorial experimental design with three levels of DMSO and four levels of commercial fertilizer supplied by the Dixie Guano Company. Tobacco, heavily fertilized in the field, shows significant growth differences with respect to fertilizer treatment, but no significant differences could be attributed to the DMSO treatments. Corn, lightly fertilized in the field, showed some interesting effects with respect to both fertilizer and DMSO treatments. Corn treated with 50% or 25% of the normal field application of fertilizer grew slightly more than plants treated with the normal amount of fertilizer if 10 ppm DMSO was added. In the case of certain experimental groups significance could be attributed to both fertilizer treatment and DMSO treatment.

(186)

Effects of 2-Thiouracil and 5-Fluorouracil on the Morphology of the Root of Bunch Bean (*Phaseolus vulgaris*)

PATRICIA PERFETTI

University of Tennessee at Chattanooga

JAMES D. CAPONETTI

University of Tennessee at Knoxville

Bean seeds were sterilized and subjected to one of two treatments. Treatment No. 1 seeds were germinated for 48 hours in a given concentration of 2-thiouracil, 5-fluorouracil or distilled water. The seeds were then planted in vermiculite. These seedlings were allowed to grow for four weeks and were watered with distilled water. Treatment No. 2 seeds were treated similarly except that the seedlings were watered with the same concentrations of inhibitor as that in which they had germinated. The concentration of inhibitor in treatment No. 2 thus gradually increased with watering. After four weeks, measurements and observations of the root morphology were recorded, and the roots were prepared for sectioning. Roots in both treatments showed a reduction in dimensions with increasing concentration. Little effect was evident in the internal morphology of the root in treatment No. 1. Treatment No. 2 had similar results except that earlier maturation, as evidenced by secondary activity, was observed.

(45)

Planktonic Copepod (Crustacea: Harpacticoida) Distribution and Regulating Factors in the Pamlico River Estuary

DAVID S. PETERS

From 1966 to 1968 over 450 zooplankton samples were collected from the Pamlico River Estuary. The abundance of planktonic harpacticoid copepods varied from zero to 18,000/m³. The highest density observed was twice as great as the maximum of all other plankters combined. Harpacticoids are frequently present at night but most of them leave the water column during the day. This early morning exit was observed while vertical illumination at the surface, although increasing, was still less than 30 lumens/m². There was no apparent trend relating harpacticoid abundance to the type of benthic substrate. Nocturnal abundance is positively correlated with wind speed and may be explained as a correlation between vertical mixing and either passive, or as seems more likely, active transport.

(55)

Environmental Effects on the Pigmentation of the Blue-green Alga, *Chlorogloea fritschii*

JOHN D. PIKE, Georgia Southern College

A technique involving preliminary lyophilization and disruption of cells of the blue-green alga, *Chlorogloea fritschii*, has been devised. This is the first reported successful extraction and quantitative measurement of the major pigments of this organism. Selected cultures grown in different media, light intensities, and temperatures for different periods of time were analyzed for pigment content. The chlorophyll:carotenoid ratio was found to be higher in cultures grown in sucrose than in cultures grown in inorganic medium. This ratio was found to decrease as light intensity increased. Dark-grown cultures had pigment levels comparable to light-

grown cultures. Phycocyanin levels were higher in cultures grown with nitrate than in nitrogen-fixing cultures. The significance of these results as compared to the results of others will be discussed.

(137)

Vegetation of Southern Highland Rock Outcrops

J. DAN PITTILO AND J. H. HORTON

Western Carolina University

An investigation of over 300 vascular species from over 20 outcrops of North and South Carolina and Georgia at elevations ranging from 1700 to 5700 feet revealed little consistency among outcrops. Species such as *Krigia montana* and *Saxifraga michauxii* were found at all elevations; *Ptelea trifoliata* and *Callicarpa americana* were found only at lower elevations; whereas *Rhododendron catawbiense* and *Scirpus cespitosus* var. *callosus* occurred only at higher elevations. Some species, as *Callicarpa americana* and *Vaccinium arboreum* are southern and occurred in the piedmont foothills, but the more northern *Maianthemum canadense* and *Potentilla tridentata* occurred only at high elevations. Some are very rare and restricted in this area, as *Robinia kelseyi* and *Senecio millifolium*. The data suggest that the vegetation of outcrops is more closely associated with local seed sources than the unique xeric conditions which are usually thought to determine the species constitution of outcrop communities.

(4)

Poisonous Snakebite East of Mississippi

GEORGE PODGORNÝ, Forsyth Memorial Hospital

Biologist hazards a poisonous snakebite on each field trip. This is particularly true of the Southeastern United States. Treatment of poisonous snakebites should begin with prophylaxis. Avoiding exposure and taking protective measures is the beginning. A biologist must be conversant with the first aid and know in general what the treatment should consist of. Southeast abounds with Copperheads, Rattlesnakes and Coral snakes are present in Florida. Heathy adults would recover easily from a Copperhead bite. Local wound care, pain relief and an antibiotic are usually all that is needed. A short hospitalization is advisable. The use of antivenin is not indicated because it is rarely needed to save life or limb, and furthermore it sensitizes one to horse serum. However Rattlesnake or Coral snake bites are extremely dangerous and require prompt medical care and administration of a specific antivenin. Incision, suction and cryotherapy all are inefficient methods and should be condemned.

(141)

The Organic Content of Shells, Tissues, and Extrapallial Fluid of Some Estuarine Pelecypods and Its Ecological Implications

T. J. PRICE, G. W. THAYER AND M. W. LACROIX

The distribution of the total organic matter among the shell, the tissues, and the extrapallial fluid of estuarine molluscs is being measured. Thus far *Crassostrea virginica*, *Mercenaria mercenaria*, *Tagelus plebeius*, *Argopecten irradians*, and *Modiolus demissus* from North

Carolina, *M. demissus* from Virginia and New Jersey, and *M. demissus granosissima* from Florida have been analyzed. The organic matrix of their shells contained from 12.2 (*A. irradians*) to 71.9 percent (*C. virginica*), the tissues from 25.5 (*C. virginica*) to 84.2 percent (*A. irradians*), and the extrapallial fluid from 2.6 (*C. virginica*) to 9.1 percent (*M. demissus* from North Carolina). Thus, since molluscs are important estuarine herbivores, and since the organic matrix of their shells rarely is assimilated by carnivores or other organisms, the production of molluscan shells represents a drain on the productive capacity of an estuary.

(156)

Variations in Nitrogen Content with Plant Elevation in the Marsh Grass, *Spartina alterniflora*

WILLIAM H. QUEEN, *University of South Carolina*

Nitrogen content of *Spartina alterniflora* collected at different elevations in the marsh has been investigated. Total nitrogen was found to comprise 1.56, 1.02 and 0.65 percent of the dry weight of leaf blades, stems, and roots respectively of plants from the upper third of the vertical range. Percentages of 2.08, 1.37 and 1.05 were found in corresponding parts of plants for the lower third of the vertical range. While seasonal changes in percentages were found, the relationships between plant parts and between corresponding parts from the upper and lower sections of the vertical range did not change. Possible explanations for these variations in nitrogen content with plant position in the vertical range of the species will be discussed.

(84)

RADFORD, ALBERT E. (please see page 24)

(136)

Correlation of Altitude and Heat Accumulation with Progression of Flowering of Two Common Understory Tree Species across North Carolina

JOHN S. RADFORD, *University of North Carolina*

North Carolina's diverse climate and physiography provide for very interesting analyses of phenophase-environment interactions. In the spring of 1970, *Cornus florida* (Dogwood) and *Cercis canadensis* (Redbud) specimens were located and dates of first flower opening observed for each species by a state-wide network of some 300 persons. Data analysis was initiated by correlating phenophase date and point co-ordinates (altitude, longitude and latitude), with special emphasis on the altitudinal variation. One major environmental parameter, heat accumulation, was studied in detail. Correlation of heat sums and flowering were made for representative data points and for systematically chosen point values generated in computer-calculated isophene and heat-sum maps. Problems discussed in relation to the overall study include species in homogeneity, observational bias, delineation of appropriate data regions and the related problem of possible computer interpolation of false data.

(117)

The Effects of Acid Mine Pollution on the Fish Population of the North Anna River, Virginia

JAMES R. REED, *Virginia Commonwealth University*

The North Anna River, a major tributary of the York River system, has received acid mine wastes for nearly 100 years. The combined effects of acidity and the deposition of sediments caused by mine drainage have severely altered the fish population and diversity in the river. The fishes upstream from the source of pollution, Contrary Creek, are typical of a Piedmont-Coastal Plain stream of this type. Twenty-three species representing seven families were collected. Downstream from Contrary Creek the river appears superficially to be as suitable for fish life as does the upstream area, but the number of species collected was 50 to 60% less than above the source of pollution. It appears that the river is in a recovery phase from acid mine pollution although the actual point of complete recovery downstream has not yet been determined.

(208)

Autoradiographic Analysis of Mitotic Blockage in Grasshopper Neuroblast Cells Induced by Cold Exposure

MARSHALL E. REESE, JR. AND J. GORDON CARLSON
Institute of Radiation Biology and Department of Zoology and Entomology, The University of Tennessee

Embryos of the grasshopper *Chortophaga viridifasciata* (DeGeer) equivalent to 13 days development at 26°C were placed at 11°C for 40 days, after which over 99% of the neuroblast cells were blocked in interphase. At the end of this period they were cultured at 38°C for 1, 2, 4, or 8 hours in a solution of glutamic acid-glycine containing 1μC of tritiated thymidine per ml. After each exposure 4 embryos were fixed, squashed and autoradiographed. The number of grains was determined in an area of 100 square microns over each of 50 neuroblasts per embryo. The grain counts indicate that very few cells are synthesizing DNA through 2 hours, the number increasing slowly through 4 hours, and rapidly from 4 to 8 hours. These results might be due to cold induced mitotic blockage at G2, or the rapid recovery of prophase reverted cells. (This study was supported in part by Atomic Energy Commission Contract AT-(40-1)-2575).

(119)

Preliminary Report on Geographic Variation and Distribution of *Floridichthys carpio* (Pisces: Atheriniformes, Cyprinodontidae), with Comments on Southern Killifish Distribution

KENNETH RELYEA AND JULIAN HUMPHRIES
Jacksonville University

The distribution of the Gold-Spotted Killifish, *Floridichthys carpio*, is incompletely known. Our studies indicate that this species is continuously distributed from Cedar Key on the Gulf Coast of Florida southward to the Florida Keys and the Miami area. A disjunct population exists on the east coast of Florida in the Indian River between Titusville and Melbourne, Florida. We have not been able to confirm the existence of the species on the Texas coast and doubt its occurrence there. Another disjunct population occurs in Mexico. Its relationship to Florida populations merits study. The dis-

junct population of *Floridichthys* on the east coast of Florida shows considerable parallel to the distribution of other coastal killifishes. This problem is discussed in a present and historical context.

(122)

Fishes of the Saline River, South-central Arkansas

JAMES T. REYNOLDS, *Northeast Louisiana University*

The Saline River, a major tributary of the Ouachita River in south-central Arkansas, arises in the foothills of the Ouachita mountains north of Benton and flows generally south for approximately 150 miles until it junctions with the Ouachita River, west of Crossett.

The Saline River, as yet unaltered by impoundments and without extensive previous survey work, was thoroughly collected during 1969 and 1970. Eighty-four species, totaling 30,108 specimens were taken in 57 collections from 32 locations. Significant extensions of known ranges of several species is reported.

(183)

A Cytochemical Analysis of Callose Distribution in *Lilium longiflorum* (Monocotyledoneae) Pollen Tubes

JOHN D. REYNOLDS AND WILLIAM V. DASHEK
Virginia Commonwealth University

Callose, a β , 1-3 glucan, as a component of plant cells has received sporadic attention. Prior to establishing its synthesis, transport and function we attempted to cytochemically localize callose in lily pollen tubes. Aniline blue, lacmoid and resorcinol were used for visualizing callose. Staining occurred in the thin wall of both the non-growing and tip regions of short tubes but not in the tips of longer tubes. Plugs (callose deposits?) exhibiting an affinity for the above stains were never seen. Examination with phase optics revealed non-staining wall ingrowths (WI) in fixed-tubes and free-moving cytoplasmic masses (FCM) within living tubes. WI and FCM resembled callose plugs appearing as rose-colored structures of varying size and shape. Wall stainability was eliminated by β , 1-3 glucanase and KOH but WI and FCM were not affected. These findings suggest that the tube wall contains callose and that WI and FCM are either non-callosic or alternatively composed of a form lacking affinity for callose staining and extraction. Mechanical agitation of living tubes resulted in aggregations of intensely staining vesicles bearing a striking resemblance to callose plugs.

(34)

The Effects of Altitude, Soil Moisture and Soil Acidity on Earthworm (Oligochaeta: Acanthodrilidae and Lumbricidae) Density, Biomass and Species Diversification in *Liriodendron tulipifera* L. Stands in Two Areas of East Tennessee

JOHN W. REYNOLDS, *The University of Tennessee*

Fifteen sites were selected between the 795 and 3050 foot elevations at Oak Ridge National Laboratory and Great Smoky Mountains National Park during the summer of 1969. The study shows that nine species of earthworms are present, representing seven genera. Seven species have not been previously reported in Tennes-

see while the eighth may be a new species. The maximum number of species occurring in any single site was five, three being the more usual. The relative abundance and biomass of earthworms were directly affected by soil acidity; which was correlated with an interaction between soil moisture and elevation.

With an increase in elevation one would expect the following generic complexes to dominate the earthworm populations: *Diplocardia* - *Octolasion*, *Diplocardia* - *Octolasion* - *Bimastos*, *Octolasion* - *Bimastos* - *Pheretima*, *Octolasion* - *Pheretima* - *Dendrobaena*, and *Octolasion* - *Bimastos*. Earthworm densities ranged from 1.6 to 55 per m². Wet weight biomass estimates were 4.2 to 168.6 g/m². This maximum biomass value was 60% and 95%, respectively, of values reported in American and European literature for comparable ecosystems.

(112)

WAYNE L. RICKOLL AND W. DONALD FATTIG
(please see page 33)

(30)

Soil Moisture Characteristics of Different Ecosystems on the Little River Watershed, Georgia¹

JERRY C. RITCHIE², CAROLE A. RITCHIE³
AND GAYTHER L. PLUMMER⁴

Soil moisture characteristics of 12 soil-vegetation ecosystems were studied to determine the effect of soil characteristics and of vegetation type on soil moisture change. Moisture determinations were made daily using the neutron moderation method. Monthly moisture profiles were made from measurements made at two-inch intervals. Total soil moisture differences were subject to both soil characteristics and vegetation characteristics. Grass sites had more moisture in their profiles than woodland sites probably due to rooting characteristics. The soil with higher clay content had higher moisture content. Considering the total soil moisture balance, each of the 12 ecosystems had a different soil moisture pattern. Evapotranspiration rates of the 12 ecosystems were most closely related to soil moisture content and soil texture.

¹ Contribution of the USDA Sedimentation Laboratory and the S.E. Watershed Research Center, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture in cooperation with the University of Mississippi and the Mississippi Agriculture Experiment Station.

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(106)

Light and Electron Microscopy of Mitotic Aberrations in a Mammalian Cell *in vitro*

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University of Florida

Streptonigrin (SN)-induced mitotic aberrations in rat kangaroo cells (line PtK₂) were studied with the light and electron microscope. The frequency of aberrant meta- and anaphases was 100% in cells treated for 4 hrs. at 37°C with 0.05 μ g/ml SN, 49% in cells treated with 0.01 μ g/ml SN, and 14% in untreated control cells. The mitotic index in SN-treated cells was lower than in the controls. Aberrations observed included

multipolar spindles; maloriented metaphase chromosomes; chromosomal bridges, laggards, and fragments in ana- and telophase cells; nuclear bridges and micronuclei in late division stages. None of these was specific for SN. The higher concentration of SN induced complex aberrations and decondensed chromosomes in meta- and anaphase cells. Ultrastructural aberrations of kinetochores, centrioles, continuous and kinetochore microtubules, were studied in abnormal cells and compared with normal structures. The possible relationship of these aberrations with abnormal spindle formation and chromosome movement will be discussed.

(130)

Prediction of Tree Growth from Old Field Vegetation

ELIZABETH ROPER AND H. R. DESELM
The University of Tennessee

In 1938-9 plantations of softwoods and hardwoods were established on old fields in East Tennessee on the peninsula between the Clinch and the Powell Rivers. The old field vegetation on each planting site was grouped into types which were compared with the heights of three tree species after 30 years. Absolute cover greater than 60% was paralleled by an increased *Liriodendron tulipifera* height of five feet but no cover effect was seen in *Pinus strobus* or *Pinus echinata*. Increased cover by *Digitaria* spp. *Verbesina occidentalis*, *Ambrosia elatior* and *Lespedeza* spp. was paralleled by an average height of 54 feet compared with an overall mean *Liriodendron* height of 44 feet. Height growth in the upper half of the height range occurred on *Ambrosia* stands by *P. strobus* and *P. echinata*. The broomsedge field type exhibited about average height growth by all three taxa.

(14)

A Report of the Fishes Collected in the Clinch River

ROBERT D. ROSS AND MICHAEL T. MASNIK
Virginia Polytechnic Institute

A preliminary report on the distribution of fishes in the Clinch River basin in Virginia is presented. The results of 23 collections made in the Clinch River proper, between Blackford, Va., and Clinchport, Va., and tributaries Little River, Copper Creek, Big Cedar Creek, and Little Cedar Creek are summarized. The collections were made between November, 1969, and September, 1970. An annotated list of 57 species in twelve families is compiled. New records for the drainage basin in Virginia are *Etheostoma cinereum*, *Notropis whipplei*, and *N. ariommus*. The range for several other species is extended further upstream. *Camptostoma anomalum michauxi* of Fowler is validated and redescribed comparatively for six characters throughout its range. All fish examined are currently in the V.P.I. Vertebrate Museum, Blacksburg, Va. (Research supported in part by the Appalachian Power Company.)

(44)

The Distribution of Fresh-Water Protozoans on Abaco Island, Bahamas

JEANNE A. RUTHVEN AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

The cosmopolitan distribution of fresh-water protozoans was examined on Abaco Island, Bahamas by: (1) taking samples from surface waters; (2) exposing containers of sterile water to colonization; and (3) culturing soil samples. Fifty-five percent of those genera found in surface waters were also found in soil samples. Other species common only to soil samples probably act as a reservoir group which furnishes colonizing species should a suitable aquatic habitat be present. Number of species found was not dependent on soil type, although kinds of species will naturally depend on characteristics of the substrate. Very few species (range of 0-6 per container) were collected from jars of exposed sterile water. The variation in numbers and kinds of species found in surface waters is probably due to variations in water quality while differences in number of species found in the containers may indicate some variation in air-borne invasion rate since water quality was essentially the same. (We are indebted to the Center for Aquatic Biology, Eastern Michigan University for travel funds used in this project.)

(32)

Ammonia as a Significant Nitrogen Source for Antarctic Freshwater Ecosystems.

I. Uptake and Effects

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Virginia Polytechnic Institute and State University

Preliminary studies of a number of fresh-water ecosystems near the U.S. Palmer Station during January 1969 revealed two lakes with strikingly different "Trophic" stages. Ammonium and phosphate levels differed most markedly among the numerous physical, chemical, and geological features examined. Laboratory experiments using simulated aquatic ecosystems and field experiments during 1969-70 antarctic summer support the view that ammonium is the key factor regulating "Trophic" features in these two lakes.

(101)

A Study of Variations in Embryonation Time for the Ova of *Trichuris trichiura* (Linnaeus, 1771) Stiles 1901

ROGER G. SARGENT AND FELIX H. LAUTER
University of South Carolina

Ova collected from infected individuals in South Carolina were used to contaminate various types of soils in the outdoor environment. The soils were contaminated on the first day of each month for twelve successive months. Soil samples containing the ova were collected on the 10th, 20th, 30th, and other selected dates with subsequent removal and observation of the ova. The ova were classified as one-celled, two-celled, early morula, late morula, tadpole, embryonated, and degenerate. The observed developmental stages were then assigned numerical values thus allowing for the various periods of the year to be evaluated in terms of its favorability

for the development of the ova of *Trichuris trichiura*.

The data collected revealed information of special importance in terms of the capacity of *Trichuris* ova to over-winter and complete development in the spring.

(97)

A Study of Variations in Embryonation Time for the Ova of *Ascaris lumbricoides* (Linnaeus, 1758)

ROGER G. SARGENT and FELIX H. LAUTER
University of South Carolina

Ova collected from infected individuals in South Carolina were used to contaminate various types of soils in the outdoor environment. The soils were contaminated on the first day of each month for twelve successive months. Soil samples containing the ova were collected on the 10th, 20th, 30th and other selected dates with subsequent removal and observation of the ova. The ova were classified as one-celled, two-celled, early morula, late morula, tadpole, embryonated, and degenerate. The observed developmental stages were then assigned numerical values thus allowing for the various periods of the year to be evaluated in terms of its favorability for the development of the ova of *Ascaris lumbricoides*.

Of special interest in this study is the prolonged periods required for embryonation during the winter months.

(90)

The Rediscovery of the Bi-annulate Leech, *Oligobdella biannulata* (Moore, 1900), in the Mountain Streams of South Carolina (Annelida: Hirudinea)

ROY T. SAWYER, *College of Charleston*

The discovery by Moore seventy years ago of a primitively bi-annulate leech, *Oligobdella biannulata*, on the salamander, *Desmognathus quadrimaculatus* (= *nigra*), from a single locality in the mountains of North Carolina, promised to shed light on the evolution of the basically tri-annulate Hirudinea from the uni-annulate Oligochaeta. However, this phylogenetically intriguing species has not fulfilled these expectations because it has remained unknown since the limited original description. The rediscovery of *O. biannulata* in mountain streams of South Carolina greatly extends its known range as well as suggests that it is a valid species which is much more common than the earlier literature would indicate. On four occasions in Oconee County, South Carolina, *O. biannulata* was found only on the salamander, *D. quadrimaculatus*: on 6 June 1966 (N = 9; average size = 2.7 mm; range = 2.2-3.0 mm; from one host) in Crane Creek on Winding Staircase Road; on 27 May 1967 (N = 34; average size = 3.8 mm; range = 2.1-5.5 mm; from more than one host) in a stream near the Walhalla Fish Hatchery; on 17 August 1969 (N = 12; average size = 1.7 mm; range = 1.5-2.0 mm; from one host) and again on 25 March 1970 (N = 4; average size = 4.3 mm; range = 3.3-5.0 mm; from one host) in Yellow Branch Stream picnic area, on Highway 28, northwest of Walhalla. On a fifth occasion, 21 November 1970, one adult *O. biannulata* (7.0 mm), which was brooding 37 young (1.3-1.8 mm) on its ventral surface, was found free-living under a stone in a small stream

in Table Rock State Park, Pickens County, South Carolina. An account of the morphology and biology of *O. biannulata*, and its phylogenetic significance is being prepared.

(200)

Algae in Tobacco Beds

HAROLD E. SCHLICHTING, JR.
North Carolina State University

Mixed populations of algae have been collected from the surface and from a three-inch depth in tobacco beds prior to and after fumigation, fertilizer application, watering and planting. Twenty genera of algae were cultured in soil water, Bold's Basal and Gorham's Media. Green algae dominated the beds in number of genera present with the blue-green and yellow-green algae together making up less than 30% of the species present.

(140)

Night Life High in the Colorado Rockies

RONALD R. SCHMOLLER, *The University of Tennessee*

Certain groups of insects, myriapods, and arachnids were collected by pitfall trap at 3,600-4,270 m (11,800-14,000 ft) elevation in the Colorado alpine tundra. The Cicadellidae (leafhoppers), Lygaeidae (lygaeid bugs), Acrididae (grasshoppers), Formicidae (ants), Scarabaeidae (scarab beetles), Cantharidae (soldier beetles), Erythraeidae (erythraeid mites), Lycosidae (wolf spiders), and Thomisidae (crab spiders) appear to be mainly diurnal taxa. The Carabidae (ground beetles), Diplopoda (millipedes), Phalangida (harvestmen), Gnaphosidae (gnaphosid spiders), and Micryphantidae (dwarf spiders) appear to be mainly nocturnal taxa. The low catches of certain nights and days may have been due to wet or cold conditions. A brief study at 4,270 m (14,000 ft) indicates that the nocturnal arthropod fauna extends even to this high altitude. Many noctuid moths were observed flying at night at 14,000 ft although the air temperature was only 2-5°C. The nocturnal arthropod fauna of high altitude alpine tundra is shown to be of considerable size, contrary to earlier opinions. The cold night conditions (ca. 1-4°C) do not halt all arthropod activities. The arctic tundra is shown to lack most of the alpine tundra nocturnal taxa, most probably due to lack of night conditions during summer.

(56)

The Transport of Auxin in the Primary Root of *Zea mays*

T. K. SCOTT and MRIDUL BATRA
University of North Carolina, Chapel Hill

The uptake and the movement of auxin in 6-mm sub-apical segments of the primary root of *Zea mays* L. Burpee cv. Snowcross were investigated using 1-¹⁴C and 2-¹⁴C indolyl-3-acetic acid (IAA) applied in agar blocks. Counts made of the donor blocks, receiver blocks, and the tissue indicate that differential recoveries are due to differences in the uptake of auxin and its transport rather than to its destruction by the segments. In segments taken from roots grown in a horizontal position, approximately 4 times as much radioactivity was recovered from the receiver block placed on

the apical end than from the one placed on the basal end after a transport time of 6 hr. If the roots are oriented in a vertical position 12 hours previous to the time of harvesting, the ratio of recovery is increased to 20:1. Thus, there is an acropetal polar flux of auxin through these segments which can be altered and intensified by changing their orientation with respect to gravity. The role of auxin in root growth will be discussed.

(52)

Chlorophyll Production and Retention in Mustard Seedlings

PREM P. SEHGAL, CLAUDE L. HUGHES,
BRENDA E. PUGH AND THOMAS M. VICARS
East Carolina University

The effects of arginine and kinetin on chlorophyll production and retention in three-day old mustard seedlings were investigated. Kinetin (200 μ M/l) inhibits production of chlorophyll by about 25 percent. Promotion of retention by kinetin, however, reaches a level of about 75 percent when compared to the control after a period of six days in the dark. Arginine at 10^{-3} M promotes both production and retention by about 20 percent. The interaction of arginine and kinetin showed that kinetin does not appreciably affect the arginine enhancement of chlorophyll production in etiolated seedlings. Similarly arginine does not appear to affect the promotion of chlorophyll retention by kinetin. The effects of other sources of nitrogen including monosodium glutamate will be discussed as to their mechanism of action.

(191)

An Enzymatic Survey of Some *Polyporus* Species using Starch Gel Electrophoresis (Basidiomycetes)

MICHAEL C. SHANNON, S. K. BALLAL
AND JOHN W. HARRIS
Tennessee Technological University

Taxonomic relationships between 17 isolates of nine species of the wood rotting fungus, *Polyporus*, were examined using starch gel electrophoresis, coupled with histochemical staining procedures. Crude extracts of 21 day cultures grown on malt extract agar were subjected to electrophoresis for three hours at a constant current of 25 mA. Nonspecific esterases, peroxidases, and acid and alkaline phosphatases were analyzed. The enzymes catechol oxidase and galactose dehydrogenase were also examined. For each enzyme, the bands occurring in each isolate were compared with those of other isolates and of other species. A method of comparing the banding patterns was devised, based upon the number of bands of similar migration rate shared by the different isolates. For each species examined, there was a close relationship between the banding patterns of different isolates, even in cases in which significant morphological variations were observed in culture. This technique may provide a valuable tool for the establishment of phylogenetic relationships among the Basidiomycetes.

(127)

Population Dynamics of Two Plant Species in Granite Outcrop Communities

REBECCA R. SHARITZ, *Saginaw Valley College*

If a natural community is truly a dynamic system, descriptions of community structure should include fluctuations which occur in component populations. Population attributes including density, distribution, biomass, seed production, and survival provide such descriptions if measured at significant stages throughout the life cycles of natural populations. *Sedum smallii* (Britt.) Ahles (Crassulaceae) and *Minuartia uniflora* (Walt.) Mattf. (Caryophyllaceae), two pioneer plant species of island communities on granite outcrops in the southeastern United States, were studied in order to describe community structure in these terms. Actuarial life tables were constructed to express quantitatively the dynamics of these populations. The hypothesis that population fluctuations and corresponding community structure of these outcrop communities are primarily influenced by soil depth, soil moisture, and biotic competition was tested by an experimental analysis conducted in a programmed environment laboratory. Final verification of the hypothesized cause and effect relationships of these factors to population dynamics was obtained via a return to a modified field environment.

(76)

An Unreported Structure in the Mosses: Multicellular Chlorophyllose Filaments on the Setae of a Moss in the Hookeriaceae

A. J. SHARP, *University of Tennessee*

A member of this family recently collected in Mexico has sporophytic setae from which have grown chloroplast-containing filaments 4 or 5 cells in length. Setae of this and other families often have papillae on the surface but they represent only a portion of a cell. The moss was collected on branches of a shrub in a deeply shaded and damp habitat.

(146)

A Feasibility Study Using Conservation Webbing as an Artificial Substrate

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Virginia Commonwealth University
AND
AVIS WINFIELD
Virginia Commonwealth University

Conservation Webbing, a thermoplastic sheet of non-woven fibers $\frac{1}{8}$ to $\frac{1}{2}$ inch thick, has recently been marketed by the 3-M Corporation as a sampling substrate. A study was conducted on a small woodland stream to determine the effectiveness of the material to collect representatives of the macrobenthos which existed in the natural habitat. Even though the webbing collected only 63% of the macrobenthic species known to inhabit the stream, the substrate did collect certain species of aquatic insects which were either not as abundant in routine collecting or missed completely. The collection of uncommon species of the macrobenthic community makes the substrate ideally suited for life history studies of certain species of the bottom fauna community.

(74)

Induction of Gastrolith Formation in Crayfish by Exogenous Ecdysterone

JAMES W. SMILEY, *Northeast Louisiana University*

Ecdysterone (20-hydroxyecdysone) was capable of initiating precocious premolt activities in two species of crayfish as evidenced by gastrolith formation and the synthesis of a new cuticle under the old exoskeleton. The effect of ecdysterone was quantitated by measuring gastrolith diameter relative to carapace length at daily intervals following ecdysterone injection. Male intermolt *Procambarus clarkii* and *Cambarus sciotensis* were injected with ecdysterone (dissolved in 10% ethanol) through an articular membrane of the third or fourth walking leg. Control animals received an equal volume of 10% ethanol. To determine a dose-response relationship 5 animals were injected with each of the following dosages: 0.05 µg/g body weight, 0.25 µg/g body weight, 0.5 µg/g body weight, 2.5 µg/g body weight and 5 µg/g body weight. All dose levels except the lowest were capable of initiating gastrolith formation and the maximal response after five days was obtained with the highest dosage. Using the 5 µg/g body weight dose level 5 crayfish of each species were injected and sacrificed for dissection at 24, 48, 72, 96, and 120 hours post-injection. Gastroliths were present in all experimental animals as early as 24 hours post-injection. Daily increase in gastrolith diameter was indicative that only a single exposure to ecdysterone was necessary to initiate molt preparation. A new cuticle had been formed under the old as early as 48 hours post-injection in some animals and was always present at 72 hours. None of the control animals formed gastroliths or synthesized a new exoskeleton during the course of the experiments.

(69)

Coughing and Other Respiratory Symptoms in Bluegills (*Lepomis macrochirus* Rafinesque) Exposed to Lethal and Sublethal Concentrations of Zinc

RICHARD E. SPARKS, GLENN SUTER, II,
ROGER A. McNABB AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

Recordings were made of pressure changes in the mouths and gill cavities of 15 bluegills exposed to zinc concentrations of 3, 6, and 20 mg/l (5 fish at each concentration), 6 bluegills exposed to 40 mg/l, and 2 control bluegills exposed to water containing no added zinc. The mean weight of the 23 fish was 39.97 gms (S.D. = 10.45 gms) and the mean standard length was 10.62 cm (S.D. = .77 cm). At zinc concentrations of 20 and 40 mg/l, which were lethal to some fish within 24 hours, the breathing rates increased over a period of several hours, then decreased rapidly within an hour before death. Maximum coughing frequencies of individual fish exposed to 20 or 40 mg/l zinc ranged from 3.3 to 31.3 coughs/min. At sublethal concentrations of 3 and 6 mg/l, mean coughing frequencies increased from 0.8-1.1 coughs/min. to 1.9-4.1 coughs/min. within seconds after the introduction of zinc. Further breathing irregularities appeared after several hours. The mean coughing frequencies were proportional to the zinc concentrations. (This research was supported by the Manufacturing Chemists Association and Federal Water Quality Administration grant 18050 EDQ.)

(107)

ST. AMAND, W. (please see page 24)

(184)

A Study of Some Embryological Features of *Cornus* by the Use of a Clearing Technique (Angiospermae: Umbellales: Cornaceae)

BRUCE B. SMITH AND J. M. HERR, JR.
University of South Carolina

The application of a clearing fluid composed of lactic acid, chloral hydrate, phenol, clove oil, and xylene, in conjunction with dissection and squashing of ovules, proves useful for the study of embryological features in *Cornus*. Whole flowers fixed in FPA₃₀ and stored in 70% ethanol have an optimal clearing time of four days. Observations of megasporogenesis and megagametogenesis with phase contrast microscopy is best achieved by the study of nucellus dissected from excised ovules and squashed in the clearing fluid on a slide. The unitegmic, anatropous ovule of *Cornus* contains a laterally flattened, slightly crassinucellate nucellus. Consistently the chalazal megaspore in each linear tetrad is functional, and degeneration of the defunct megaspores is not synchronous. The two-nucleate megagametophyte develops before the defunct megaspores completely degenerate. Considerable variation occurs in megagametophytes at the four-nucleate stage with regard both to size and to the position of the nuclei. Because the apical nucellus is consumed throughout megagametophyte development, the eight-nucleate stage is in direct contact with the integument and, therefore, is somewhat difficult to remove.

(103)

Nucleic Acid Precursors and Chromosome Aberrations in *Tradescantia paludosa* Microspores Irradiated in Air

RICHARD STALLARD, *Emory University*

Microspore chromosomes were used to investigate possible DNA synthesis following 400r of x-rays delivered in air. Pretreatments in air with common free bases, ribosides, deoxyribosides, triphosphates, and deoxytriphosphates indicated that some compounds known as allosteric regulators and some compounds metabolically convertible to allosteric regulators of enzymatic ribonucleotide reduction significantly increased chromosomal aberration yields. Posttreatments in 20% oxygen and 80% carbon monoxide indicated that the effective compounds decreased recovery. Increased aberration yields were not attributable to radiomimetic properties of effective compounds or the experimental procedures. Pretreatments with 5-fluorodeoxyuridine, posttreatments in helium, and pretreatment depletion of periplasmic ATP significantly increased aberration yield as well. It is probable that increased aberration yield following pretreatments with the effective compounds resulted from inhibition of ribonucleotide reduction and that the recovery process in *Tradescantia* microspores involves a DNA repair mechanism.

(23)

The Vegetation of Northern New England Salt Marshes

RICHARD STALTER, *Brookgreen Gardens, S.C.*

The vegetation of six salt marshes north of Boston, Massachusetts, to Eastport, Maine, were sampled by means of the line intercept method (Canfield 1941), during June and July, 1969. A surveyor's transit was used to determine the range of the salt marsh species above datum (mean low water) in these marshes. Soil samples were taken and analyzed for total active ion population (conductivity) and salinity. The dominant species found in these marshes listed in order of increasing elevation above datum are *Spartina alterniflora*, *Salicornia* spp., *Spartina patens*, and *Juncus jerardi*. Factors that influence the distribution of the salt marsh species are duration and depth of flooding, salinity, and total active ion population.

(77)

Breaking Male Sterility in *Impatiens sultani* Hook. f. by Hybridization (Malvales: Balsaminaceae)

SHELTON E. STEWART, *Lander College*

Impatiens sultani Hook. f. was introduced into America from Zanzibar and has escaped from gardens into natural habitats. One male sterile specimen was selected from a group growing in Central America for observations. The plant has shown no evidence of male fertility for several years, after having been grown under various environmental conditions and treated with a variety of chemicals, such as colchicine and gibberellic acid. However, by hybridizing this plant with male fertile varieties, viable offspring are produced which are male sterile. When the first generation was crossed back to the male fertile parents, some male fertile offspring resulted.

(116)

Observations on Winter Habitats of Various Darters (*Etheostoma* and *Percina*) in Tennessee's Little River

ROBERT A. STILES AND JERRY F. HOWELL
University of Tennessee

Using scuba equipment observations were made of the winter habitats of various darters (*Etheostoma* and *Percina*). Species included in these observations were *Percina aurantiaca*, *Percina evides*, *Etheostoma simoterum*, *Etheostoma zonale*, *Etheostoma camurum*, *Etheostoma rufilineatum*, *Etheostoma maculatum*, and *Etheostoma blennioides*. It was found that a species may show changing habitat preferences as water conditions change.

(169)

Development of Thermoregulatory Ability and the Thyroid Gland in Embryonic Japanese Quail, *Coturnix C. japonica* (Aves, Galliformes)

RICHARD L. STOUFFER, ROGER A. McNABB
AND F. M. ANNE McNABB

Virginia Polytechnic Institute and State University

Prenatal development of thermoregulatory ability was studied in the embryos of Japanese quail. Thermocouples were implanted inside the egg shell membranes to determine the rate of temperature decline in eggs placed in a 30°C airbath. Daily measurements showed that the embryos' resistance to cooling gradually increased during development. By 10-12 days of incubation, thyroid follicles were present. Thyroid activity appeared maximal by 13-15 days, then declined slightly before hatching. Developing quail embryos showed some characteristics of endothermy, but at no stage prior to hatching could they be considered homeothermic. (This study was supported by a grant from the American Museum of Natural History).

(139)

Prediction of Stem Weight from Height and Diameter in *Spartina alterniflora*

LINDA M. STROUD AND A. W. COOPER
North Carolina State University

Estimation of living standing crop values were made on short, medium, and tall *Spartina alterniflora* growth forms. The plant material was collected by the clip plot method during June, July, and August, 1965. The sample consisted of sixty 0.1m² sample plots. In the laboratory, the living stems were arranged in order by height. Ten stems from the total number in the sample were randomly selected. Height, weight, and diameter measurements were made on these ten stems. This data was subjected to a multiple regression program to determine if height, weight, and diameter were correlated in *Spartina alterniflora*. Correlation coefficients of 0.94 were obtained for regressions of weight on height and weight on height and diameter. Thus, it seems that if height is known, weight can be predicted with a reasonable degree of accuracy. This suggests a method of estimating standing crop in a much quicker way than harvesting.

(98)

Further Studies of Some Gastrointestinal Helminth Parasites of the Cattle Egret, *Bubulcus ibis* (Aves, Ciconiiformes, Ardeidae)

JEANNE J. STUART, JOHN F. DISMUKES
AND CARL F. DIXON
Auburn University

Thirty cattle egrets from locations in Alabama and Georgia were examined for the presence of gastrointestinal parasites. Twenty-eight of these birds hosted parasites. The following nematodes were found: *Microtetrameres spiralis* (Nematoda, Tetrameridae), *Tetrameres cochleariae* (Nematoda, Tetrameridae), *Synhimantus invaginatus* (Nematoda, Acuariidae), *Physaloptera* sp. (Nematoda, Physalopteridae), *Habronema* sp. (Nematoda, Spiruridae), *Hadjelia* sp. (Nematoda, Spiruridae).

and *Amplichaecum* sp. (Nematoda, Heterocheilidae). Trematode parasites recovered included the following: *Nephrostomum ramosum* (Trematoda, Echinostomatidae), *Clinostomum complanatum* (Trematoda, Clinostomatidae), and *Apatemon gracilis* (Trematoda, Strigeidae). No cestode parasites were found. The finding of *T. cochleariae*, *C. complanatum*, and *A. gracilis* constitute new host records in North America.

(8)

Notes on the Georgia Blind Cave Salamander, *Haideotriton wallacei* (Amphibia: Plethodontidae)

BRUCE SUTTON AND KENNETH RELYEA
Jacksonville University

The Georgia Blind Cave Salamander is known from a few scattered localities in Florida and Georgia. It may be relatively abundant where encountered. Its main food items are troglobitic crustaceans. Possible pathways of energy flow in the cave system in Jackson County Florida are discussed. A blind cave crayfish, *Cambarus cryptodytes*, is the only known predator of *Haideotriton*, and may be responsible for spacing of the salamander in the pools which it inhabits. The reproductive cycle of *Haideotriton* is incompletely known, and suggestions which may help elucidate this aspect of the life history of the species are made.

(150)

The Destruction of Gametes and Early Cleavage Stages of *Crassostrea virginica* by Mild Heat Shock

BERYLL TAYLOR AND FRED K. PARRISH
Georgia State University

Eggs, sperm, one-cell, and two-cell developmental stages of *Crassostrea virginica* (Gmelin) were heat shocked for five minutes at 32, 33, 34, and 35 C. Control groups at 24 C, as well as all experimental groups had some gastrulae which developed abnormally. Sperm gave rise to 49% abnormalities, whereas, eggs, one-cell, and two-cell stages developed 100% abnormalities at 35 C. Eggs, sperm, one-cell, and two-cell stages developed with approximately 9% abnormalities at 24, 33, and 34 C. Optimum development of 1 to 4% abnormalities was attained at 32 C for all stages.

Oysters have adapted to normal environmental variations in temperature. The limit of thermal tolerance for larvae, 35 C, lies approximately 4 C above the highest mean monthly water temperature, 31 C, during the breeding season. Optimal developmental temperature, 32 C, lies within the normal range of environmental temperatures of the breeding season. Artificial warming of Southern estuaries could work against these very early developmental stages to the detriment of species survival in this region.

(138)

Retention of 1-44 μ Simulated Fallout Particles by Soybean and Sorghum Plants

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Six-week-old soybean and sorghum plants were contaminated in the field with a siliceous fallout simulant containing ^{137}Cs . Initial fallout interception and retention of particles by whole plants and plant parts were determined for a five week period.

Initial interception of particles was similar with values of 39.5 and 38.2% of the deposition quantity retained by soybeans and sorghum respectively. The sites of initial interception, however, differed greatly between species.

Weathering half-lives for particles were determined for different plant parts and two time components—0-7 and 7-34 days following deposition. Half-life values were similar for the 0-7 day component, but differences between species and plant parts were found for the 7-34 day component. (Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.)

(48)

Standing Crop, Biomass, and Respiration of the Epibenthic Invertebrate Community of an Eelgrass Bed

GORDON W. THAYER AND MICHAEL W. LACROIX

Species composition, numerical abundance, respiration, caloric content, and biomass of the epibenthic invertebrates collected from a shallow embayment in the Newport River Estuary, N.C., were measured monthly during 1969-70. Biomass ranged between 206 (November) and 2,520 mg. dry weight/m.² (June), and the energy content of this biomass from 715 to 10,672 cal./m.². Gastropods dominated the community, averaging 78 percent of the total population and 55 percent of the dry tissue biomass. Community respiration was correlated with temperature and biomass and ranged from 8.7 (December) to 441.3 cal./m.²/day. Assuming that respiration required 75 percent of the energy assimilated by these invertebrates, they assimilated an amount equivalent to 12.3 percent of the estimated daily net production of phytoplankton, benthic algae and eelgrass in this embayment.

(161)

Isoperoxidases of Germinating Peanuts (*Arachis hypogaea* L.)

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Dormant seed and organs of 1, 2, 5, 8, 11, and 14-day old plants were homogenized in phosphate buffer and the lipid-free extract electrophoresed in starch gels and polyacrylamide disc gels. Using benzidine as a hydrogen donor, no peroxidase activity was detected in dormant cotyledons but one weak cathodal band was observed in the dormant axis. Peroxidase activity increased signifi-

cantly in epicotyl and hypocotyl-radicle tissues but to a lesser extent in the cotyledons of two-day old plants. On a wet weight basis, the peroxidase activity as demonstrated by the number of bands and intensity of reaction decreased in the cotyledons, epicotyl, and hypocotyl through day 14; the activity and band characteristics in the roots were more uniform during the same period. Four to six bands, mostly cathodal, were observed in starch gels at gel pH 8.65. Up to 12 bands were observed in polyacrylamide disc gels. Using pyrogallol as a hydrogen donor, both anodal and cathodal bands were observed in starch gels. The disc gels were less distinctive. Implications of the results are discussed.

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(57)

Sr Substitution for Ca and Algal Cell Size

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AND JOSEPH C. O'KELLEY
University of Alabama

Mature cells of some algal species that will grow in a medium with Sr substituted for Ca are larger and more highly vacuolated than control cells in Ca. In logarithmic phase cultures, average cell size of cells in Sr replacement medium is greater than for control cells in Ca. The water content of Sr replacement cells is indicated to be greater than that of control cells. Mechanisms whereby water content and cell size differences may become established are discussed.

(145)

Community Structure of the Macrobenthos in Four Tributaries in the Pre-Impoundment Basin of the North Anna River, Virginia

M. H. THOMAS, *Virginia Water Control Board*
AND

G. M. SIMMONS, JR., *Virginia Commonwealth University*

Virginia Electric Power Company plans to construct a nuclear fueled power station on the North Anna River in Louisa County, Virginia with a 14,500 acre reservoir to serve as coolant for the reactor. A study is currently being conducted to evaluate existing, pre-impoundment benthic communities and water quality which are strongly influenced by acid mine drainage from three abandoned pyrite mines on a tributary, Contrary Creek. The North Anna River below the confluence of Contrary Creek is in the process of recovery but lacks the molluscan element of the benthic community which is present above its confluence. A study of the macrobenthic invertebrates was made in the tributaries to the North Anna River below Contrary Creek in an effort to determine which elements were being re-introduced into the recovery zone. This study showed that within the tributaries a diversified molluscan population was present. Siltation is presented as the primary factor restricting recolonization of molluscs in the recovery zone.

(93)

Antarctic Ciliated Protozoa

JESSE C. THOMPSON, JR., *Roanoke College*

Extensive collections of protozoa were made within a 40-mile radius of Palmer Station located on Anvers Island. Animals were collected, cultured, and impreg-

nated with silver nitrate according to the Chatton-Lwoff Technique. Numerous genera were identified from both freshwater and marine environments.

(111)

Insemination Frequencies in *Drosophila equinoxialis*

J. IVES TOWNSEND, RAGNIT GEERAETS
AND RICHARD A. BANKS
Medical College of Virginia
Virginia Commonwealth University

When equal numbers of males and females of *Drosophila equinoxialis* are confined together for 24 hours, the females of only one (Tefé, Brazil) of five geographic strains show a relatively limited receptive period. Frequency of insemination has a bimodal distribution in three other strains (Honduras, Trinidad, and Venezuela), and also in the remaining strain (Puerto Rico) if confinement is extended for 48 hours. Experiments in which one male is confined with various numbers of females and other experiments in which various numbers of males and females are confined together show that the maximum frequency of insemination results among 5-day old Trinidad flies only if at least 10 males and 20 females are confined together. (Supported in part by NIH Grant GM 12682.)

(195)

Evaluation of the Nutritional Data for *Phlyctochytrium* and *Rhizophydium*

GILBERT S. TRELAWNY, *Madison College*

A survey of the nutritional data for 7 species of *Phlyctochytrium* and 3 species of *Rhizophydium*, (Class Chytridiomycetes; Order Chytridiales), indicates that substrates which may be of differential value between these two genera are trehalose, glycerol, lysine, and nitrite. No member of *Rhizophydium* has been found to metabolize trehalose or glycerol when offered as the sole source of carbon, nor to utilize nitrite or lysine when these provided the sole source of nitrogen. Most species of *Phlyctochytrium*, however, used these compounds. In addition, lactose has been utilized by all three species of *Rhizophydium*, but not by any members of *Phlyctochytrium*. Thiamine has also been found to be required by all species of *Rhizophydium* examined, but by only a few species of *Phlyctochytrium*.

(75)

Temporal Synergism of Prolactin and Corticosterone in the Regulation of Fat Stores in the Lizard, *Anolis carolinensis*

TERRY N. TROBEC AND ALBERT H. MEHR
Louisiana State University

Two groups of adult male lizards, *Anolis carolinensis*, maintained on continuous light and at 30 C. were injected daily with corticosterone (1 μ g/gm body weight) for a period of 14 days. One group was injected at 0600 and the other group at 1800. Each of these two groups was further subdivided into four groups which received daily prolactin injections at 0, 6, 12, and 18 hours after the corticosterone injection. The prolactin injections were initiated five days later than the corticosterone injections and continued for nine days. The weight of the abdominal fat bodies (expressed as per-

cent body weight) was used as an index of fat stores. Prolactin injections given six hours after the corticosterone injection (regardless of whether the corticosterone injection was given at 0600 or 1800) induced fat loss, whereas prolactin injections at 18 to 24 hours post-corticosterone elicited fat increase. (This work was supported by NSF Grant GB-02913.)

(159)

Nucleic Acid Synthesis and Development in *Volvox aureus* M5

ROBERT G. TUCKER AND WILLIAM H. DARDEN, JR.
University of Alabama

This paper reports the normal course of RNA and DNA synthesis during the vegetative life cycle of *Volvox aureus* M5 and discusses developmental effects observed after inhibition of synthesis of these macromolecules by actinomycin D and mitomycin C. Total RNA and DNA are determined at 12 hour intervals during the complete vegetative life cycle (approximately 65 hours with the growth conditions used). Maximum amounts of both RNA and DNA are found in the 36-48 hour developmental stage. Mitomycin C at 45 $\mu\text{g}/\text{ml}$ and actinomycin D at 4 $\mu\text{g}/\text{ml}$ prevent subsequent development when administered at any of the developmental stages. These antibiotics are shown to be specific at the concentrations used. Actinomycin D inhibits RNA synthesis approximately 87% with negligible effect on DNA synthesis and mitomycin C inhibits DNA synthesis about 91% with no appreciable effect on RNA synthesis. The significance of these results relative to vegetative development in *Volvox* are to be discussed.

(64)

Effects of Gamma Radiation and Temperature on the Biological Assimilation and Retention of ^{137}Cs by *Acheta domesticus* (L.)¹

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Information concerning factors affecting elemental retention provides insight into both physiological responses of species involved and nutrient dynamics of the ecosystem they inhabit. Temperature and radiation dose are two of the more important abiotic factors influencing animals living in ecosystems contaminated with radioactive materials (e.g., fallout). Thus, determination of the effects of these two factors on element retention would aid in developing models describing the dispersion of these elements in this ecosystem. In the present study, ^{137}Cs retention was determined for brown crickets, *Acheta domesticus*, which had been irradiated with 1000, 2500 and 5000 rads gamma radiation and maintained at 20, 25 and 30 C.

Increases in temperature and gamma dose resulted in a general decrease in the percent ^{137}Cs assimilated per day. The loss rate coefficient (k_1) for unassimilated ^{137}Cs was not significantly affected ($P \leq 0.05$) by either temperature or dose changes. The biological elimination coefficient (k_2) for assimilated ^{137}Cs increased with increasing temperature but decreased with increasing dose. For controls, 1000 and 2500 rads, a 10 C rise in temperature resulted in a doubling of k_2 . At 5000 rads,

however, k_2 no longer responded to changes in temperature.

¹ Research sponsored by the U.S. Atomic Energy Commission and the Office of Civil Defense, Department of Defense, under contract with Union Carbide Corporation.

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(134)

A Call for Suggestions of Natural Areas in the Oak-Pine and Southeastern Evergreen Forests of the Southeast

GARY S. WAGGONER, *North Carolina State University*

The National Park Service under its Natural Landmark Program is conducting a study of the Eastern Deciduous Forest. North Carolina State University is completing an inventory of potential Natural Landmark areas within the Oak-Pine and Southeastern Evergreen Forest regions. There is no limit on size for areas to be suggested. They may be privately or publicly owned. These sites should display characteristic vegetation of the region or disjunct communities. Communities with endemic species can also be suggested, as well as areas demonstrating successional stages. A primary purpose of the program is to encourage and assist private individuals and organizations in protecting and preserving the relatively few natural areas remaining. The NPS performs the final evaluation of sites. After acceptance by the Park Service, the owners requesting registration must agree to comply with basic conservation practices relating to management and protection.

(163)

Aspects of the Phenolic Acid Distribution in the Cycadaceae

JAMES W. WALLACE, *Western Carolina University*

A chromatographic survey for hydroxy benzoic and hydroxy cinnamic acids in the 10 extant genera of the Cycadaceae indicated that p-coumaric, caffeic, ferulic, p-hydroxy benzoic, protocatechuic, and vanillic acids were present in each of the species studied. In addition sinapic acid was identified in *Dioon spinulosum* Dyer. ex. Eichl. and *Ceratozamia mexicana* Brongn. demonstrating that it has a wider distribution among vascular plants than was previously indicated.

(210)

Histology and Histochemistry of the Embryonic Chick Mandible Following X-Irradiation

BARBARA ANN WALTON
University of Tennessee at Chattanooga

The sensitive period for the induction of reduced mandibles in chick embryos, with x-irradiation, was determined to be 5 days of incubation. Variations in mandibular anomalies were correlated with incidence and frequency of cell deaths. The variety of anomalies resulting from teratogenic doses is due, in part, to differences in sensitivity between embryos and their ability to recover from the radiation damage. Smaller, but normally proportioned mandibles developed as a result of a weak response to irradiation. Mandibular cartilage bends representing an intermediate response, resulted from differentially sensitive connective tissue primordia.

Primordia of all tissues were severely affected in a distoproximal order in the most severe form of the anomaly. Histochemical tests demonstrated that chondrification and ossification were occurring normally with a 12 to 1 day retardation in the latter process. Membrane bones were stunted and conformed to abnormally curved and/or bent cartilage. AMP dephosphohydrolase mesenchymal activity may be correlated with developing osteogenic centers.

(192)

Relationship of Soil Microfungal Populations to Tree Populations

JOHN E. WARD, JR., *High Point College*

AND

G. T. COWLEY, *University of South Carolina*

A study of soil microfungal populations in relation to tree populations of 12 central South Carolina forest stands representing four habitat types (sandhill pine-scrub oak, loblolly pine, pine-hardwood and floodplain hardwood) has been conducted. Frequencies of occurrence were determined for all microfungal entities and used to calculate indices of similarity between populations. The populations were spatially arranged by constructing ordination diagrams based upon population similarity.

The hypothesis that species composition of soil microfungal communities is correlated with species composition in the plant cover was supported by the fact that ordinations of stands based on tree populations and those based on microfungal populations were similar. Although several microfungi were widespread, they were isolated from different areas in varying frequencies indicating apparent community relationships. The overlapping in different stands resembled that of some of the tree species. Thus, apparently microfungi are organized at the community level; however, these communities are not completely discrete.

(72)

Observations on the Neurosecretory Cells of *Lehmannia poireiri* (Mabille) under Osmotic Stress

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Four groups of the terrestrial mollusk, *Lehmannia poireiri* (Mabille), were injected with varying concentrations of saline solution. The circumpharyngeal nerve rings were dissected out, embedded in paraffin, sectioned at 7 microns and stained with paraldehyde fuchsin. The degree of osmotic stress was correlated with the distribution of neurosecretory material (NSM). The most medial neurosecretory cells (NSC) of the meso- and metacerebra were depleted of NSM one to three hours after injection with high concentrations (8%) of NaCl. Other cytological details of the NSC, including multiple nucleoli, acidophilic nuclei, and basophilic inclusions are also described.

(129)

Standing Crop Estimates of Several Dominant Marsh Plants in Virginia

MARVIN L. WASS, *Virginia Institute of Marine Science*

Square meter samples of the species of plants indicate a great variation in yield, depending on elevation, exposure, season and salinity. Data to date indicate *Leersia oryzoides* most productive, followed closely by *Spartina cynosuroides* and *S. alterniflora*. Some species, such as *Nuphar advena* and *Peltandra virginica* are much more difficult to assess, due to growth habit. Comparisons are made with studies in other southeastern states.

(85)

Oleaceae of Mississippi

J. RAY WATSON, *Mississippi State University*

The Oleaceae (Olive Family) are represented in Mississippi by eleven indigenous species and varieties. The most widely distributed taxa are *Chionanthus virginicus* L., *Forestiera acuminata* (Michx.) Poir., *Fraxinus americana* L., *F. americana* var. *biltmoreana* (Beadle) J. Wright ex Fern., *F. caroliniana* Mill., *F. pennsylvanica* var. *subintegerrima* (Vahl) Fern. and *Osmanthus americana* (L.) Gray. Of more restricted or localized distribution are *Forestiera ligustrina* (Michx.) Poir., *Fraxinus pennsylvanica* Marsh., *F. quadrangulata* Michx. and *F. tomentosa* Michx. f. In addition, *Ligustrum* is represented by several non-indigenous species, the most common and widely distributed species being *L. sinense* Lour.

(105)

DNA and Protein Synthesis in the Liver of the Heterozygous Grey-Lethal Mouse (*Mus musculus*) (Mammalia: Rodentia: Muridae)

ROBERT M. WELCH, *West Georgia College*

The homozygous grey-lethal mouse suffers from a single gene recessive mutation apparently involving parathyroid metabolism. Previously observed retardation of DNA synthesis in the heterozygote (Whitten, R.D. and R. M. Welch, 1969, *J. Cell Biol.* 43: 157a) suggests a possible interference in protein synthesis. Microinterferometric analysis, however, of liver nuclei and total liver weights in 24 mice at 28, 35, and 42 days of age yield data compatible with expected distribution of values in normal mice and so do not support the hypothesis of protein involvement. Hence the mutation in the heterozygous state apparently exerts no influence in this respect on selective fitness. The fact, however, that protein low values show normal distribution and no increase from 35 to 42 days while the DNA curve is skewed towards the low values, which do increase in the same period, confirms retardation in DNA synthesis in the heterozygote and supports the implication of the parathyroid in DNA metabolism.

(66)

The *in vitro* Endrin Effect on Succinic Dehydrogenase Activity in Endrin-Resistant and Susceptible Mosquitofish (*Gambusia affinis*)

MARION R. WELLS AND JAMES D. YARBROUGH
Mississippi State University

Comparisons of succinic dehydrogenase activity of liver and brain mitochondrial preparations from endrin-resistant and susceptible mosquitofish demonstrate endrin enzymic inhibition in susceptible tissues and stimulation in resistant tissues. Repeated freezing and thawing of susceptible and resistant homogenates leads to endrin inhibition of enzymic activity in all preparations. This indicates a membrane barrier to endrin as a possible resistance mechanism in vertebrates.

(31)

The Ecological Life History of *Uvularia perfoliata* L.

DENNIS WHIGHAM, *University of North Carolina*

The ecological life history of *Uvularia perfoliata* L., a member of an endemic genus of spring flowering perennials of eastern United States forests, was examined. Sexual reproduction, initiation of asexual reproduction, and attainment of maximum plant height were completed before closure of the overhead canopy. Obligate outcrossing appears to be the system of sexual reproduction and a Coleopteron insect of the suborder Staphylinidae is the vector. Asexual reproduction occurs by formation of new plants at the termini of stolons. Density of populations studied varied from 481-55 plants/m² and the number of flower bearing individuals varied from 0-12.7% of the populations. 68% of the plants examined reproduced asexually. Mean dry weight biomass of individuals was .273gm and asexually reproduced plants were established a mean distance of 18.7cm from parent plants. Seeds were transported by ants. The question of how sensitively this climax species is adapted to its habitat will be discussed.

(16)

A New Percid Fish of the Genus *Ammocrypta* from Western Florida and South-eastern Alabama

JAMES D. WILLIAMS
Mississippi State College for Women

A new species of *Ammocrypta* is described from the Perdido, Escambia, and Choctawhatchee Bay drainages in western Florida and southeastern Alabama. The new species is most closely related to *A. beanii*, but differs from *A. beanii* by having a dark marginal and submarginal band on the median fins. In *A. beanii* the fin pigment is restricted to a dark blotch on the anterior spines of the first dorsal fins and a median band on the anal and soft dorsal fins. The range of *A. beanii* extends from the Mobile Basin west to the Big Black River, a tributary to the Mississippi River in central west Mississippi. The presence of a disjunct population of *A. beanii* in the Hatchie River in southwestern Tennessee is discussed as possibly being the result of capture from the upper Tombigbee River drainage.

(15)

Fishes from the Blackwater River in Florida and Alabama with Zoogeographic Notes

JAMES D. WILLIAMS AND JAMES L. WOLFE
Mississippi State College for Women
Mississippi State University

A survey of the Blackwater River system, a tributary to Escambia Bay, was conducted from the summer of 1967 to the winter of 1968. A total of 65 collections were made from 41 localities. On the basis of this survey, records of the Florida Freshwater Fish Commission, and the Florida State University Museum, the ichthyofauna was found to consist of 74 species representing 24 families. Of the 74 species, 20 are euryhaline or marine species. The remaining 54 species are freshwater forms with geographic distributions east and west of the Blackwater River system. Several freshwater species which are widespread and common in the Gulf Coast drainages appear to be absent in the Blackwater System.

(53)

Effect of Calcium on Live and Dead Uptake of ⁸⁵Strontium and ¹³⁷Cesium by *Cladophora* and *Pithophora*

LOUIS G. WILLIAMS, *University of Alabama*

At the point where growth and photosynthesis per respiration is zero in solutions low in calcium the addition of calcium has the effect of greatly increasing the uptake of ⁸⁵strontium. The addition of 0.1 mg/liter of calcium and potassium when the algae were at the limiting factor point and the compensation point greatly increased the uptake of both cesium and strontium. The effect of increasing the concentration of both calcium and potassium increased the uptake of strontium but not cesium.

(133)

Transfers of Cesium-134 from a Tree Canopy to Understory Vegetation¹

JOHN P. WITHERSPOON AND MARGARET E. HERBERT²
Ecological Sciences Division
Oak Ridge National Laboratory, Oak Ridge, Tenn.

To determine pathways and rates of movement of ¹³⁴Cs leached from a tree canopy into understory vegetation, a persimmon tree (*Diospyros virginiana* L.) with a 4 m crown diameter was inoculated with 4.1 mCi of ¹³⁴Cs. Rainfall, throughfall, and understory samples were collected for a period of 8 weeks to determine amount of ¹³⁴Cs leached from the canopy and uptake by the understory, a stand of goldenrod (*Solidago canadensis* L.). Previous to inoculation, a plastic sheet was placed around each of 30 goldenrod plants. Sheets were sealed with putty around stem bases. The soil covers prevented vertical movement of ¹³⁴Cs into soil around these plants. Therefore it was possible to determine the extent of foliar versus root uptake of leached ¹³⁴Cs in throughfall.

Over an 8 week period 1.03% of the inoculum was leached from the tree crown by 13 rain events totaling 10.9 inches. About 0.04% (1.78μCi) of the inoculum was transferred to understory plants. The rate of ¹³⁴Cs

uptake by plants was three times greater through the foliar absorption pathway than through the soil-root pathway.

¹Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

²National Science Foundation Undergraduate Research Participant sponsored by Oak Ridge Associated Universities. Present address: Dept. of Biology, Florida Presbyterian College, St. Petersburg, Florida.

(33)

Ammonia as a Significant Nitrogen Source for Antarctic Freshwater Ecosystems II. Origin and Transport

E. B. WODEHOUSE, B. C. PARKER AND G. L. SAMSEL
Virginia Polytechnic Institute and State University

Location of an adelic penguin rookery just beyond the basin rim of the eutrophic lake and the obvious odors consistently detected downwind from this rookery stimulated the idea that airborne ammonia from outside the lake basin might be a major source of nitrogen-enrichment to this lake. Investigations of penguin guano composition and microbiology, release of ammonia from guano, wind transport and water-absorption of ammonia both substantiate and extend this hypothesis.

(54)

The Development of Photosynthetic Capacity by Etiolated Seedlings upon Illumination

FREDERICK T. WOLF, *Vanderbilt University*

Measurements of the time required for etiolated wheat seedlings to reach photosynthetic compensation upon illumination have been made, at temperatures of 15°, 25° and 35°, and at light intensities ranging from 125 to 8,000 fc. Most rapid development of photosynthetic capacity occurred at 25°, the time required ranging from 5½ hours at the lowest light intensity to 3½ hours at the highest intensity tested. The seedlings failed to reach the compensation point within 24 hours at combinations of 125 fc and 15°, or at 125 or 250 fc and 25°. At 15°, 12½-20 hours was required to reach compensation, temperature being the limiting factor at light intensities of 2,000 fc or above. The development of photosynthetic capacity was slower at 35° than at either of the lower temperatures. The combination of the high temperature with higher light intensities resulted in a decrease in the rates of CO₂ uptake as compared with those found at the same temperature at lower light intensities.

(114)

Attempts to Delay Death in Some Lethal Mutants of *Drosophila melanogaster*

C. PAUL WRIGHT, *Western Carolina University*

Seventeen sex-linked, lethal mutants of *Drosophila melanogaster* were studied. These mutants are nonautonomous, because patches of tissue hemizygous for the lethal genes can survive when present in individuals such as gynandromorphs which also have normal tissue. Presumably some essential chemical substance passes from the normal tissue into the lethal tissue and enables it to develop.

Attempts were made to reverse the lethality of whole organisms by supplying presumably missing, essential chemicals to the organism. It was thought that the missing chemicals might be supplied by transplanting fat bodies taken from third-instar, wild-type larvae into third-instar, lethal larvae. It is known that insect fat bodies contain many metabolic substances, such as enzymes, which are essential for normal development. Completely negative results were obtained. The transplanted fat bodies had no noticeable effects on any of the lethals. Several possible explanations for these results will be considered.

(58)

Some Effects of Different Atmospheres on Chroococcean Blue-Green Algal Acetylene Reduction

J. T. WYATT, *East Tennessee State University*

The nitrogen-fixing (acetylene reducing) enzyme nitrogenase is inactivated by O₂. Therefore, the notion that the thickwalled and photosynthetically inept heterocyst is prerequisite to aerobic blue-green algal N-fixation may still persist. In support of recent work to the contrary, five coccoid blue-green algal strains were grown in combined-N-free medium while continuously sparging with either air, N₂:Ar:CO₂ (75:20:5), N₂:Ar:CO₂ (77.96:22:04), N₂:CO₂ (99.96:04) or Ar:CO₂ (99.96:04). During short term (15-30 min) whole cell CH₃≡CH incubation, N₂ was always excluded and O₂ added only experimentally. Specific ethylene production (i.e., N-ase activity) seemed to generally parallel basic growth characteristics. The slowest growers normally exhibited least activity in all experimental atmospheres. Possible unfavorable CO₂-pH relationships limited activity of N₂:Ar:CO₂ (75:20:5) grown cultures. The substantial activity of aerobic cultures was markedly increased in both N₂:Ar:CO₂ (77.96:04) and N₂:CO₂. Nitrogen starvation under Ar:CO₂ produced excessively high N-ase activity. The presence of an inducible O₂-protective mechanism in aerobic cultures is suggested by their comparative insensitivity to up to .3 pO₂ in the acetylene incubation atmosphere.

(35)

Colonization and Persistence of Fresh-Water Protozoans in Artificial Substrates Suspended in a Small Pond in North Carolina

WILLIAM H. YONGUE, JR. AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

A series of 3" × 2½" × 2" polyurethane substrates were placed at 2½' intervals at the surface of a small artificial pond near Charlotte, North Carolina on 23 December 1969 to remain through the winter and early spring. Weekly determinations of the number of protozoan species inhabiting the sponges as well as water temperatures, pH, total hardness, and dissolved oxygen were made. Each week a sponge that had not been previously sampled was sampled and the one that had been sampled the week before was sampled for a second time. In addition seven were sampled a third time five weeks after its second sampling. A total of 96 species were identified during 18 weeks of study. Of these, 29 species had appeared (colonized the substrates) by the

end of the second week. An average of 54.8 percent of the species found in the first two samplings were "resident" species (i.e. a group that persisted throughout the study period). A 33 percent average (range 47-23) of the numbers of species found in third samplings were

present in all three samplings and 58.7 percent (range: 67-45) were found in either the first or second sampling. Such persistence tends to indicate possible protozoan community stability.

WANTED: Living *Dugesia dorocephala* collected in various areas of the U.S. Ten to twelve large specimens per spring are sufficient. Specimens needed for research on reproductive activity in different races of this species. Data needed: name of county, location of spring, water temperature, and altitude. Will pay, or will send specimens of another race of the species and/or cocoons in exchange. Write DR. M. M. JENKINS, DEPARTMENT OF BIOLOGY, MADISON COLLEGE, HARRISONBURG, VIRGINIA 22801.

ASB Candidates For Offices - 1971

The following are brief biographical sketches of the candidates for ASB offices. Voting will take place during the business meeting at noon on Friday, 16 April in Commonwealth Hall of the John Marshall Hotel.

We regret that there was insufficient time to prepare sketches of all of the candidates. Pertinent data may be found in American Men of Science for those candidates not included here. Photographs of all candidates are on the page opposite.

Perry C. Holt
(President)

Professor of Zoology at Virginia Polytechnic Institute, Dr. Holt received his B.S. from Tennessee Polytechnic Institute and his Ph.D. from the University of Virginia. Before coming to V.P.I., he taught at the University of Richmond and at East Tennessee State University. Dr. Holt has been a member of the ASB since 1948, was Chairman of the Meritorious Teaching Award Committee (1966), member of the Conservation

Committee (1967-69), Parliamentarian (1969), and is at present an Executive Committee member. In 1968 he organized the continuing series of symposia on the Distributional History of the Biota of the Southern Appalachians, co-sponsored by V.P.I. and the A.S.B.

Leland Shanor
(President)

Dr. Shanor received his A.B. from Maryville College and his M.A. and Ph.D. from the Uni-



Perry C. Holt
President
*Virginia Polytechnic
Institute*



Leland Shanor
President
University of Florida



C. Ritchie Bell
Vice-President
*University of
North Carolina*



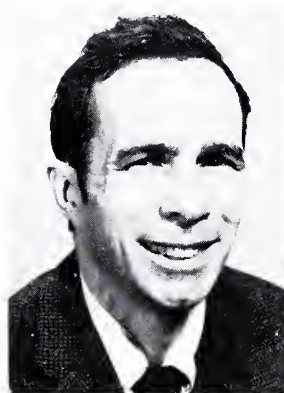
David J. Cotter
Vice-President
Georgia College



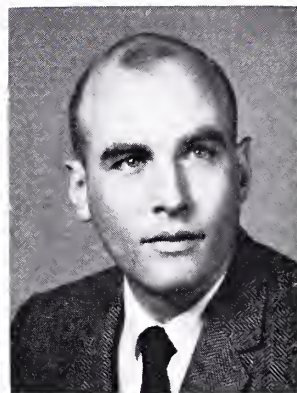
Ray O. Flagg
Treasurer
*Carolina Biological
Supply Co.*



Father John Mullahy
Treasurer
Loyola University



Stuart Bamforth
Executive Committee
Newcomb College



Arthur W. Cooper
Executive Committee
*North Carolina State
University*



Joseph F. Fitzpatrick
Executive Committee
*Randolph Macon Woman's
College*



Howard Teas
Executive Committee
University of Miami

Candidates for Election to ASB Offices - 1971

versity of North Carolina, and his D.Sc. from Illinois Wesleyan. Having taught at Clemson University, the University of Illinois, and Florida State University, he became Professor of Botany and Chairman of the Department of Botany at the University of Florida in 1965.

Dr. Shanor's principal offices and awards are as follows: Guggenheim Fellow, 1951-52; Alumni Citation, Maryville College (1965); Trustee, Highlands Biological Station 1956-), President (1958-63); Scientific Advisory Committee, Fairchild Tropical Garden (1966-); Phytotron Advisory Committee, Southeastern Plant Environment Laboratories (1968-); Board of Governors, Center for Research in College Instruction in Science and Mathematics (1967-); Botanical Society of America (Chairman, Southeastern Section, 1966); Mycological Society of America (President, 1954); Illinois Academy of Sciences (President, 1955); Association of Southeastern Biologists (Treasurer, 1962-65); Florida Academy of Sciences; AIBS; Nature Conservancy; Phi Sigma; Sigma Xi; Gamma Sigma Delta. His research has been on the biology and taxonomy of aquatic fungi and of entomogenous fungi.

Dr. Shanor is at present Vice-President of the ASB.

C. Ritchie Bell (Vice-President)

Dr. C. Ritchie Bell, Professor, Department of Botany, University of North Carolina, Chapel Hill, N.C., is also Director of the North Carolina Botanical Garden and of the Coker Arboretum.

Born in Cincinnati, Ohio, April 10, 1921, he was married in 1943. He received his A.B. from The University of North Carolina in 1947; M.A. in 1949 and Ph.D. (Botany) in 1953 from The University of California (Berkeley).

He is a member of the Botanical Society of America (Program Director 1967-1969); American Institute of Biological Science (Governing Board 1970-1973); American Society of Plant Taxonomists (Secretary 1959-1962; Council Member 1962-1968); International Association of Plant Taxonomists; Society for the Study of Evolution; American Association for the Advancement of Science; and Commission on Undergraduate Education in the Biological Sciences 1965-1970 (Chairman, Facilities Panel 1965-1967; Executive Committee 1970).

His research interests include plant evolution; cytotaxonomy of Sarracenaceae and Apiaceae (Umbelliferae) and the flora of North and South Carolina.

D. J. Cotter (Vice-President)

Dr. Cotter received three degrees from the University of Alabama, a B.S., A.B., and M.S., and his Ph.D. from Emory University. From 1958 to 1966 he was a member of the faculty of Alabama College. In 1966 he joined the faculty of Georgia College as professor and chairman of the biology department.

He joined the Association of Southeastern Biologists in 1957 and has served on the Executive Committee (1963-1966) and as treasurer (1968-1971). He has served as a Director of N.S.F. Summer Institutes for high school science teachers and N.S.F. Undergraduate Research Participation programs. He has been a Research Associate with both Emory University and the Institute of Radiation Ecology, Savannah River Ecology Laboratory. He is the author of some 18 articles. His area of research interest is radiation ecology. He is currently serving as a staff member of the Commission on Undergraduate Education in the Biological Sciences in Washington, conducting an analysis of the status of biology departments throughout the United States. He is also the Director of the Center for Regional Resources, Georgia College.

Raymond O. Flagg (Treasurer)

Director of Botany at Carolina Biological Supply Company, Ray received his A.B. from Shepherd College and his Ph.D. from the University of Virginia under the direction of Walter S. Flory. Ray studied Russian at the Army Language School and Middlebury College, taught high school mathematics, and was a Research Associate at the University of Virginia. His primary interest in the use of living materials in teaching has led to diverse developments such as inexpensive monochromatic light filters, Instant Drosophila Medium, an ATP-Bioluminescence Kit, and the Fern Mini-Marsh.

He has been chairman of the Meeting Place Committee for the ASB, and is a member of AAAS, Botanical Society of America, International Association for Plant Taxonomy, Fairchild Tropical Garden, Virginia Academy of Science, Phi Sigma and Sigma Xi. He has published in the Journal of Heredity, Nucleus, American Journal of Botany, and Stain Technology.

Father John H. Mullahy
(Treasurer)

Father Mullahy, S. J., presently Chairman of the Department of Biology at Loyola University, New Orleans, has been at Loyola since 1952. Prior to that time he was an instructor at Spring Hill College. He has been active in the ASB for many years, and has served the organization on the Executive Committee and on various standing committees. Dr. Mullahy is a member of many scientific societies, and is particularly active now as vice-president of the Southeastern Region of Beta Beta Beta.

J(oseph) F. Fitzpatrick, Jr.
(Executive Committee)

Born March 8, 1932, at New Orleans, J. F. Fitzpatrick, Jr. is Associate Professor of Biology at Randolph-Macon Woman's College. He received his B.S. and M.S. from Tulane University

and his Ph.D. from the University of Virginia where he was a Philip Francis duPont Fellow and a Henry Clay Marchant Fellow and received the Andrew Fleming Award. He was an Instructor in the Zoology department at the University of Kentucky in 1964 and Assistant Professor of Zoology at Mississippi State University (1964-1969). Among his memberships are elections to the Society of the Sigma Xi and the Phi Sigma Society; he is a Fellow of the American Association for the Advancement of Science and was a member of the AAAS Council in 1966-69. He was Associate Editor for Zoology and Entomology for the *Journal of the Mississippi Academy of Sciences* in 1967-69.

Dr. Fitzpatrick has published numerous articles, dealing principally with the systematics of North American crawfishes. He has served ASB as News Editor of the *Bulletin* (1966-70) and as a member of the Place of Meetings Committee, of which he is the current Chairman (1969-71). He is married and the father of three children.



Modern day resident uses pre-historic shelter. Photographed by Dr. George M. Simmons, Jr., Virginia Commonwealth University, this fossil tooth of the now extinct genus *Oxyrhina* sp. serves as part of a shelter for the case of the caddisfly *Hydropsyche betteni* Ross. The structure was collected by Mr. John Coe.

TREASURER'S REPORT

ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

January 1, 1970 – December 31, 1970

I SAVINGS ACCOUNTS

A. Regular Savings Accounts			
1. Savings Certificates	\$3,239.64		
Interest added	173.47		
		\$3,413.11	
2. Pass book account # 1472	\$ 704.09		
Interest added	34.02		
		738.11	
Total Regular Savings Account		\$4,151.22	
B. Contingence Savings Account	\$2,291.46		
Interest added	110.80		
Total Contingency Savings		\$2,402.26	
Total Savings			\$6,553.48

II CHECKING ACCOUNT

Balance on hand – 1/1/70		\$ 954.26	
A. Receipts			
1. Dues and Subscriptions	\$4,843.28		
2. Reprints	276.00		
3. Annual Meeting	1,907.35		
(Registration and Exhibitors fees)			
Total Receipts			\$7,026.63
B. Expenditures			
President			
Carpenter (travel)	\$ 210.86		
Hart (travel)	116.03	\$ 326.89	
Secretary			
Bliss (travel & expenses)	\$ 245.41		
Gilbert (travel)	46.64		
Office expenses	105.50	\$ 397.55	
Treasurer			
Travel	\$ 22.10		
Postage	67.14		
Supplies	41.00		
Secretarial Assistance	200.00	\$ 330.24	
Editor			
Postage and Telegraph	\$ 126.56		
Envelopes	512.17		
Secretarial Assistance	350.00		
Addressograph	235.72		
Air freight Bulletin to Meeting	31.20		
Plate and half tone prints	27.00	\$1,282.65	
Bulletin			
Vol. 17 (1)	\$ 323.34		
Vol. 17 (2)	2,142.32		
Vol. 17 (3)	320.92	\$2,786.58	
Goethe Awards		500.00	
V.P.I. - A.S.B. Symposium		500.00	
A.I.B.S. Affiliate Dues		50.00	
Membership application forms		130.00	
Executive Committee Meeting		48.88	
Conservation Committee		31.15	
Award Certificate and Testimonial Book		17.21	
Bank charges		26.30	
Lawrence C. Neal (speaker)		191.10	
Frank Flint (Travel to C.E.B. III Meeting)		195.40	
Local Arrangement Committee (Richmond)		20.00	
Total Expense		\$6,832.95	
BALANCE ON HAND: 12/31/70		\$1,147.94	

Respectfully submitted,
DAVID J. COTTER, *Treasurer*

News of Biology in the Southeast

STATE CORRESPONDENTS

Alabama — Jack S. Brown, Florence State University; James Wilkes, Troy State University

Florida — Harold J. Humm, University of South Florida

Georgia — Fred K. Parrish, Georgia State College

Kentucky — Gary E. Dillard, Western Kentucky University

Louisiana — Harry J. Bennett, Louisiana State University

Mississippi — Position Vacant

North Carolina — C. J. Umphlett, University of North Carolina

South Carolina — J. M. Herr, Univ. of South Carolina; G. Thomas Riggan, Jr., Newberry College

Tennessee — Donald Caplenor, Tennessee Technical University

Virginia — Jean Pugh, Christopher Newport College

West Virginia — Earl L. Core, West Virginia University

Jean Pugh — Editor

Dept. of Biology
Christopher Newport College
Newport News, Virginia 23601

About People

Recent appointments to the staff of the Gorgas Memorial Laboratory, Panama, include two scientists who joined the leishmaniasis program under the direction of Dr. A. Herrero.

Howard A. Christensen who received the Ph.D. degree in entomology at the University of California, Davis, joined the staff in June 1968. He is investigating the relationship of the *Phlebotomus* flies to natural and experimental infections.

Ronald J. Beumer received the Ph.D. degree at the University of Arkansas in 1970. While a student he worked on rodent ecology at the AEC plant in Aiken, S.C. Dr. Beumer is a mammalogist and is concerned

with the broad scale studies of these animals with special reference to their role as hosts of leishmaniasis.

Martin D. Young, the director of the laboratory, has been a member of the World Health Organization Expert Panel on Malaria since its inception. He has just been elected to another five year term. He is also a member of the Commissions on malaria and parasitic diseases of the Armed Forces Epidemiological Board.

Abdiel Adames, a former employee of the Laboratory, has received recently the Ph.D. degree in entomology at the University of California, Los Angeles. He has rejoined the arbovirus program and is investigating the role of mosquitoes in the epidemiology of these widespread infections.

Books and Periodicals

VEGETABLE STATICKS, Stephen Hales. American Elsevier Publishing Company, Inc., 52 Vanderbilt Avenue, New York, N.Y. 10017. 214 pp., 19 pls., 46 figs. Foreword by M. A. Hoskins, Cambridge University. Cloth, \$7.50.

Vegetable Staticks was originally published in 1727, a second edition appeared in 1731; and in 1738 it was combined with *Haemostaticks* which had been published in 1733, and printed under the title of *Statical Essays*. The last English edition came out in 1779, by this time *Vegetable Staticks* had been translated into Dutch, French, German and Italian. Almost two centuries elapsed before this valuable book was reprinted in 1961 by the History of Science Library, it was reissued in 1969 and printed in America in 1970. The text is essentially that of the 1727 edition,

"except that a few misprints have been corrected where they were likely to cause confusion. Otherwise the original spelling and punctuation have been preserved."

The text is remarkably clear and easy reading.

About a century before Hales published *Vegetable Staticks*, William Harvey had applied the experimental method in attacking a problem in animal physiology in his classic work on the circulation of the blood. However, with the exception of the limited experiments of Nicholas Cusa and Van Helmont, little or no experimental work had been done in plant physiology. In fact *Vegetable Staticks* was the first comprehensive work attempted in plant physiology. It was Hales who recognized the importance of experimental work in the field of biology. He expressed his ideas as follows:

"Since we are assured that the all wise Creator has observed the most exact proportions, of *number, weight* and *measure*, in the make of all things; the most likely way therefore, to get any insight into the nature of those parts of the creation, which come within our observation, must in all reason be to number, weigh and measure."

It is not necessary to attempt any review of the contents of this classic work, suffice it to say that, thanks to the History of Science Library, this valuable book is now available. It should be of interest to all biologists, and especially to plant physiologists. No student interested in the history and philosophy of science should be without a copy.—ELTON C. COOKE, *Department of Biology, Wake Forest University.*

CARBOHYDRATE METABOLISM. (Comprehensive Biochemistry, Volume 17.) Edited by Marcel Florkin and Elmer H. Stotz. 308 pages. \$17.00. American Elsevier Publishing Company.

This book, Carbohydrate Chemistry, is volume 17 in the series entitled "Comprehensive Biochemistry" and is edited by Marcel Florkin and Elmer H. Stotz. The book covers such topics as 1) the functional organization contributing to carbohydrate chemistry; 2) synthesis and degradation of glycogen, starch, and cellulose; 3) glycolysis; 4) hexose-monophosphate shunt; 5) neural carbohydrate metabolism; 6) aldonic and uronic acids; and 7) the metabolism of glycosaminoglycans. Absent or hastily mentioned are areas as important as pyruvate oxidation, the tricarboxylic acid cycle, and a good portion of the hexose monophosphate shunt. Pyruvate oxidation and the tricarboxylic acid cycle supposedly will be covered in volume 18 (the section on lipid metabolism).

A few specific comments about some topics covered include 1) the section on the absorption of carbohydrates relies heavily upon the mobile carrier hypothesis when other mechanisms such as a rotating carrier and facilitated uptake may also be important and as plausible; 2) in the discussions on the synthesis of starch and on the enzyme aldolase from microorganisms the activation of these enzymes by certain alkali metal ions should be indicated, and 3) the reaction on the hexose monophosphate shunt only covers the enzymes glucose-6-phosphate dehydrogenase, lactonase, and gluconate-6-phosphate dehydrogenase in detail.

Although the book does cover many topics which are out of the realm of a general biochemistry textbook, however, a good portion of the material could be obtained from a good general text. It is therefore the reviewer's recommendation that the book be purchased by libraries and specific researchers who are interested and deal with these special topics.—VERYL E. BECKER, *Wake Forest University.*

THE COMPARATIVE ENDOCRINOLOGY OF THE INVERTEBRATES, Kenneth C. Highnam and Leonard Hill. June 1970. American Elsevier Publishing Co. \$12.00.

Designed to provide a comprehensive source for the teaching of endocrinology where vivisection regulations prohibit the use of vertebrates in instructional laboratories, the authors have effectively presented the reader with an informative treatise on hormonal activities in the invertebrates. The book is clearly and precisely written. Descriptions of many pertinent experiments are found throughout the text with the evidence presented in an interesting and effective manner. Where contradictory or doubtful evidence exists, the authors give current thought and both sides of the story. Illustrations are frequent and drawn in such a way as to readily facilitate understanding by one unfamiliar with an organism or structure.

Indicative of the field of invertebrate physiology, most of the book concerns arthropod hormonal relationships with the insects representing much of this. Annelida and Mollusca are discussed in separate chapters with Coelenterata, Turbellaria, Nematoda and Echinodermata grouped into a single chapter, reflecting the extent of knowledge of the endocrinology of these groups.

In addition to comparatively evaluating the endocrinology of the invertebrates, the authors point out analogous comparisons of vertebrate hormonal functions which are also found in the invertebrates. This aspect of the book should be a particular value to those teaching physiology in the United Kingdom and others who cannot use vertebrates for laboratory demonstration. Those teaching insect physiology, cell physiology and comparative physiology should all be benefited by the many potentials of invertebrates which are described in this book.

The bibliography of the book is in itself impressive. Most of the 293 references are post-1960 vintage, many post-1965 and some within a few months of publication of the text.

The book would be an excellent reference for anyone in animal physiology. Not to be overlooked, however, is the usefulness of the information to the developmental biologist. In his teaching and also in his search for more appropriate research systems, the book provides an excellent discussion of early developmental and regulatory phenomena of many easily obtainable and maintainable organisms.—RAYMOND E. KUHN, *Wake Forest University, Winston-Salem, N.C. 27109.*

MARINE ANIMALS. R. V. Gott. 96 pp. 34 fig. American Elsevier Publishing Co., New York. Dec., 1969. \$4.25.

This slim volume deals with partnerships and other relationships of marine animals. The author presents

a brief, yet scholarly survey of these relationships with enthusiasm and humor (a chapter on phoresis is titled *The Hitchhikers*). The terms of association as he uses them are clearly defined in the introduction. Each chapter considers a specific kind of relationship. The final chapter is an interesting assessment of parasitism and how it may develop from the other types of associations.

Although written for undergraduates, this informative, handsomely illustrated book should have considerable appeal for the general reader. — LORRAINE B. SPENCER, *Wake Forest University*.

SPRING FLORA OF VIRGINIA. A. M. Harvill, Jr. Illustrated. 240 pages. \$8.50.

The book has a historical introduction; keys to families, genera, and species of flowering plants flowering before June 1; descriptions, Virginia distribution, and overall distribution of species.

This work is useful for amateur and professional botanists, students, teachers, foresters, libraries, conservation workers, and all those interested in the plants of Virginia and neighboring states.

Available from: **SPRING FLORA OF VIRGINIA**, *Darlington Heights, Virginia 23935*.

BIOLOGY OF INTERTIDAL ANIMALS. R. C. Newell. 555 p., illus., American Elsevier, New York. July 1970, \$23.75.

At the outset an "attempt to account for the distribution of intertidal animals in physiological terms" seems a formidable task indeed. However, in the *Biology of Intertidal Animals* Dr. Newell has organized and presented a compendium of physiological data on various intertidal organisms in such a way that one indeed gains considerable insight into the physiological parameters affecting intertidal distributions.

The first two chapters serve as an introduction to the pertinent physical, chemical, and biological parameters

of the intertidal zone. This involves a treatment of the pattern of zonation of intertidal organisms and some of the causes of this zonation. These sections introduce the fundamental physiological problems faced by intertidal organisms which later are to be discussed in detail.

Next follow two chapters concerned with the establishment and maintenance of zonation patterns. Particular emphasis is directed toward a review of the research concerned with the recruitment to the intertidal region of the larvae of several sedentary species. Also, the behavior patterns of several motile species are examined with respect to the role of behavior and learning in the establishment and maintenance of zonation.

What follows in the remaining 350 pages of text is an extensive treatment of feeding, respiration, and thermal stress and desiccation as they relate to the distribution of intertidal animals. Each chapter serves as a complete review of a particular aspect of the biology of intertidal animals. Where necessary the subject is introduced by background information. At no time does the author lose sight of the fact that the distribution of such animals can only rarely be interpreted in terms of a single environmental parameter. Extensive page references among various chapters serve to unite pertinent complementary pieces of information.

Although this volume contains a large amount of very specific and detailed information, it does not become encyclopedic. It is richly illustrated with many figures and tables and is very readable. Dr. Newell has drawn heavily upon information from several recent Ph.D. theses and from many as yet unpublished data of his own and of various colleagues. In addition over 35% of the more than 900 references cited are more recent than 1960. Thus, much current information is made available to the reader. Extensive subject and author indexes enhance the value of this volume as an information source.

This text should prove to be extremely useful for specialists and advanced students in various aspects of physiology and marine biology. It should also prove to be useful as a text for a course in physiological ecology. It is a welcomed addition to the literature on the biology of marine organisms. — RONALD V. DIMOCK, JR., *Wake Forest University*.



(This résumé was prepared from tapes made during the program of David Cotter of Georgia College, Howard Stein of AIBS, and John Withers of CUEBS. Any misinterpretation of the speakers' intent must be blamed on Franklin F. Flint, chairman of the program who prepared the résumé.)

A Resume of the Departmental Chairman's Meeting at the ASB Meeting on April 2, 1970, at Florida Southern College, Lakeland

FRANKLIN F. FLINT
Randolph Macon Woman's College

Presently, there is no training school for departmental chairmen. The only preparation for a person filling this position is observation of the successes and failures of other chairmen they have known. There are many factors involved in carrying out the departmental chairman's job. Perhaps the most significant single factor is that of personality. Usually departments headed by eloquent, forceful personalities who have a good grasp of local campus politics flourish. This perhaps should not be so but unfortunately seems to be. It is difficult to develop any specific criteria for the development of a good departmental chairman or for the selection process which gives him his position.

The problems of the job are more apparent. Any chairman is faced with difficulties of the budget. Financial resources in any college or university situation are finite and one has to fight diligently for any increase in budget. One of the difficulties faced by a laboratory science department is the cost of instruction. One, for example, cannot equate the cost of a history course with that of a laboratory course in biology. Consequently, one often has a selling job to do to convince any administration that additional funds are necessary to maintain a quality program in science.

Another problem that all departmental chairmen face is that of a reasonable teaching load. These contact loads will vary from one institution to another, as is indicated in the ASB Bulletin article of January, 1970, by David Cotter on conditions in the Southeast. Much interest is presently being shown by the Office of Biological Education of AIBS concerning standards and facilities. Within the next year or so there prob-

ably will be publication of concrete information concerning many attributes of biology departments across the country.

The chairman must be concerned about the entire undergraduate curriculum. This concern is particularly directed towards biology courses for non-majors, cognate courses for majors, and the preparation of majors for graduate school or jobs. In preparing majors for graduate school, one of the most difficult things to anticipate is what graduate schools will be like in the late 1970's. There is every indication that change is rapid in graduate programs now and that this will accelerate even more during the decade. There are some indications as to factors which may affect graduate programs in the next couple of decades. There probably will be considerable change resulting from an interplay of student pressure, governmental fiscal policies (both state and federal) and the job market. Federal dollars will be much harder to come by. The influence of federal funds will be greater as the funds become scarcer. There appears to be hesitancy on the part of federal agencies to give money without being very, very specific as to what the money is to be used for. The amount of money given for basic research to departments undoubtedly will be lessened in the future. This is due to the overall reduction in the National Science Foundation budget and it is due in part to the fact that the Department of Defense's funds will no longer be spent for basic research but instead will be maintained only for mission oriented projects. The money from the National Science Foundation for facilities and equipment will drop considerably. Many of the new programs are not important to biology except

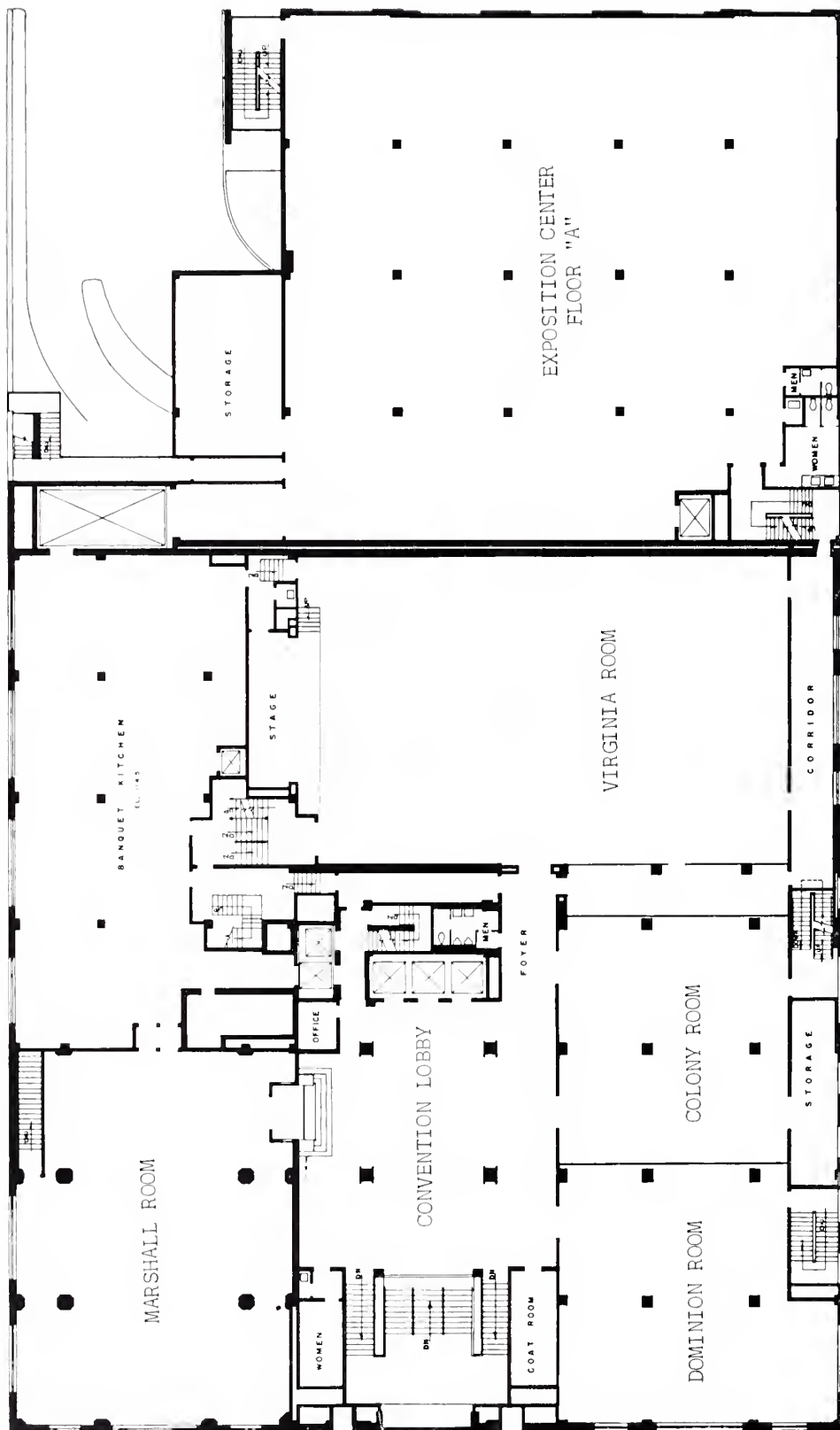
for environmental studies and the Sea Grant Programs. Unofficial talk among NSF and other people in government would indicate that there will be a commitment to problem focused education. These will usually be interdisciplinary programs concerned with practical problems which face society today. Problems such as pollution, population control, etc. Comments from a number of government officials, including Bill McElory of NSF, Al Borg, Deputy Director of Undergraduate Education, NSF and others keep mentioning interdisciplinary programs. It would seem that the search for funds should be oriented towards their interdisciplinary problems.

There is good news for chairmen interested in faculty expansion or replacement. There is an indication that there will be an oversupply of research trained Ph.D.'s. We are already faced with the beginning of this. It is not difficult to find faculty members with excellent training at the present time. The crunch comes when we have no funds to expand our program to accommodate employment of the outstanding individuals we were looking for five to ten years ago.

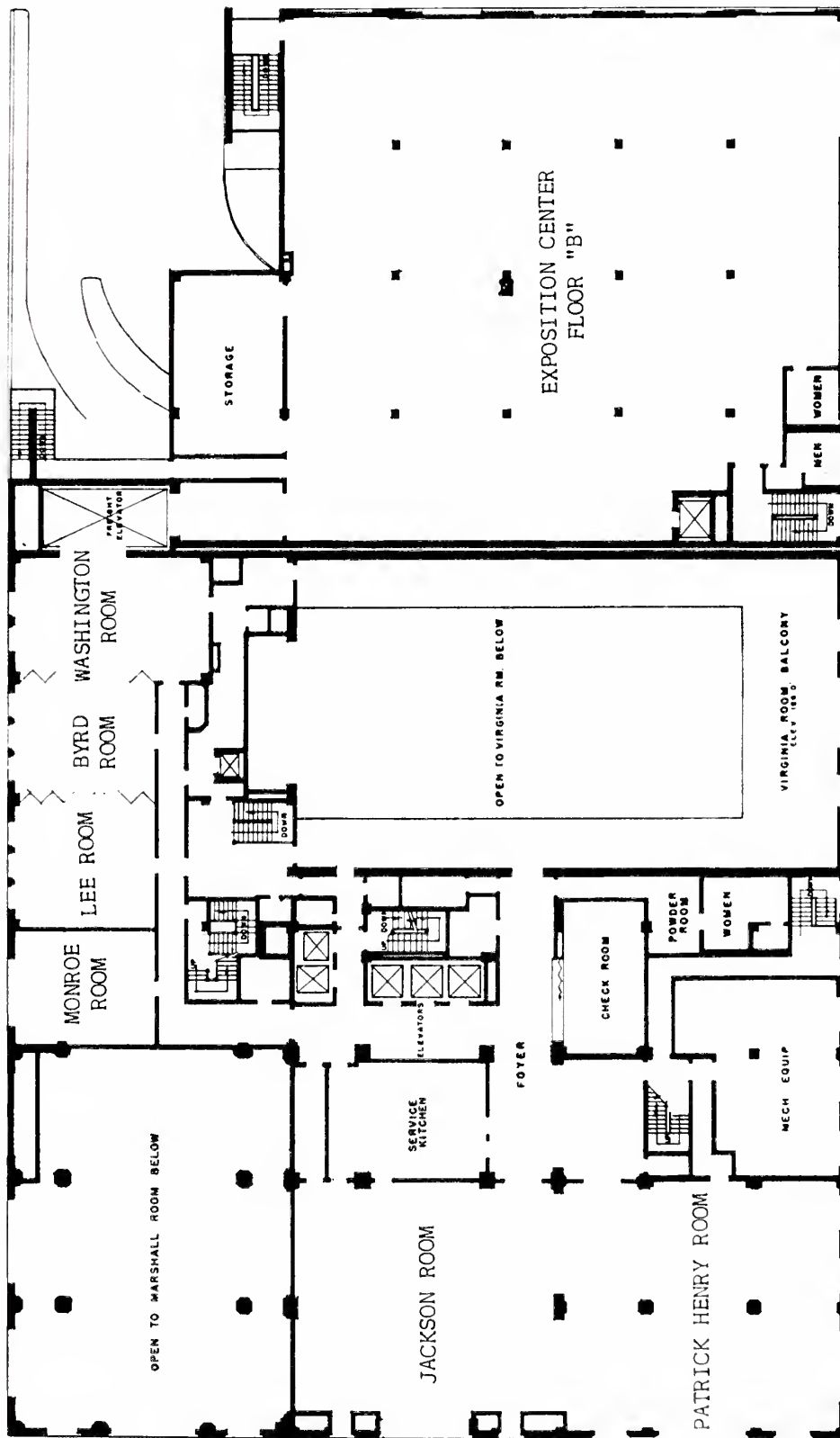
In preparing students for graduate school we must be careful not to have them specialize too early. For early specialization may lead them into an area where demand for employment is less than good. Students who are looking for graduate programs should develop a certain breadth in their undergraduate preparation. Obviously more use of statistics and computers should be included in these programs. Graduate and undergraduate combined programs in various departments such as psychobiology and environmental sciences should be developed. Greater emphasis on research or problem solving in the undergraduate program is anticipated. Demonstrable understanding of research seems more valued in graduate schools than demonstrable knowledge of factual material.

Another problem that departmental chairmen obviously will be facing is the articulation between the two year college and the four year college. Presently, individuals are looking at the two year college much as individuals look at oysters on the half shell. Those who like them praise them; those who do not have very strong emotional hangups against their existence at all. It is nevertheless true that more than 50% of all enrolled college students are in two year colleges. These two year colleges range in size from 200 students up to tens of thousands. Quite a number of them are larger than many four year institutions. The campuses are as various as any range of ideas could prescribe. Some are elaborate miniatures of old ivy colleges, others are found in abandoned

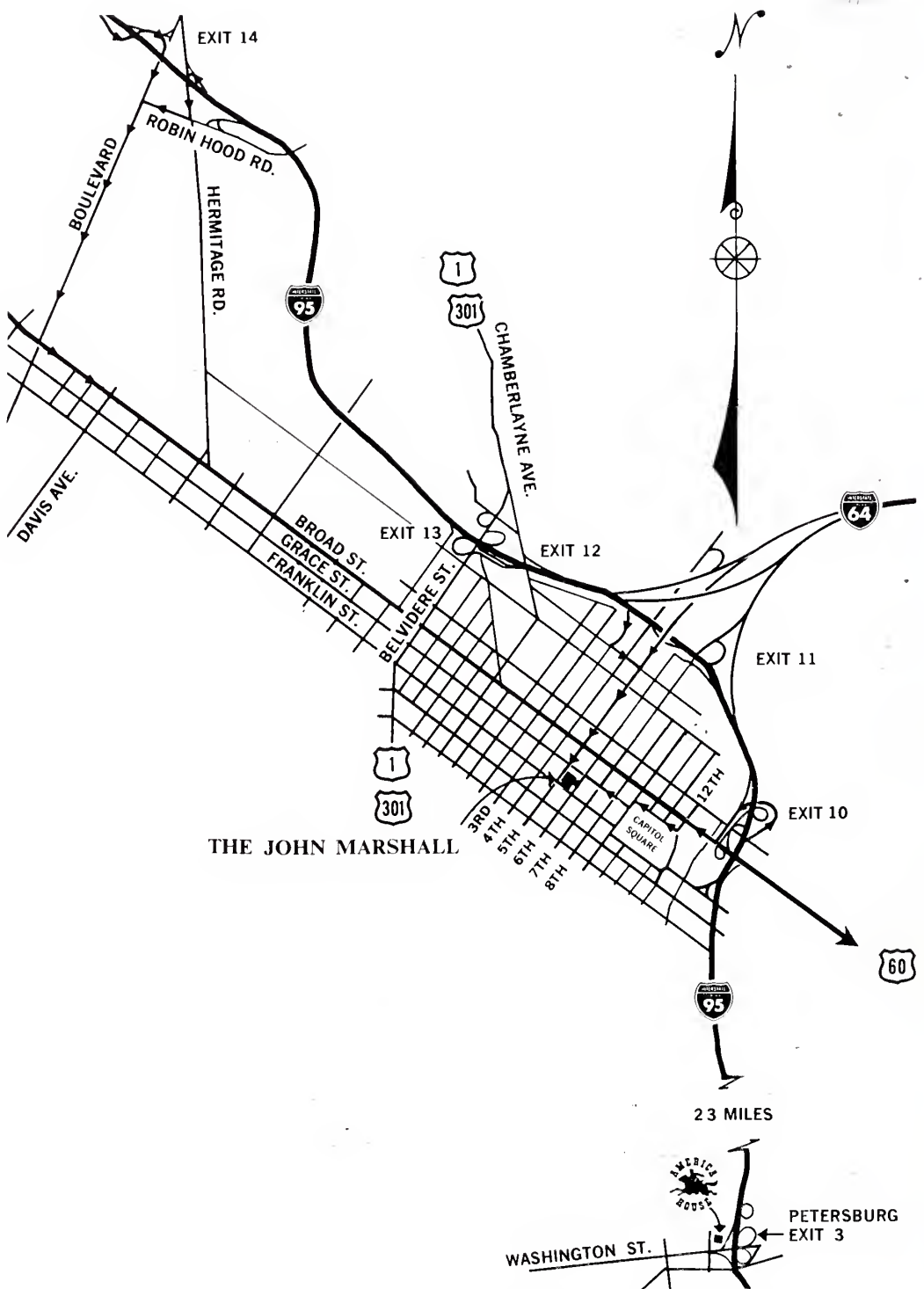
warehouses or in industrial complexes. Some observers of the college scene refer to the two year colleges as democracy's colleges. Some think of them as upgraded high schools — a halfway house between the draft or marriage or job and the family. Some call them a second chance emporium rigged in the consumer's favor. Others call them a decompression chamber guaranteeing safe passage from the depths of high schools to the upper reaches of college. Others see them as a domain of change whose agents will restructure the whole society; and others consider them a glittering midway where rubes are kept amused until time to go home. Many people are finding that in the open door policy of the two year college there is ample opportunity for experimentation and some of our best people are beginning to look at careers in such institutions. These persons recognize that the biggest problem in education yet to be solved is not what to teach our students but how to teach them more effectively. The two year college may be a training ground for development of these techniques. Articulation between two year and four year college programs is one which departmental chairmen would be wise to anticipate and to begin action on solving those in their communities. One difficulty is that two year biologists are frequently not recognized as first class citizens in the world of biology. This is true whether they have a Ph.D. degree or not. Simply by choosing to teach in a two year institution they are automatically put in a category below the rest of the college biologists. The articulation problems will give the four year college biology departments an opportunity to look critically at the work being done in community colleges near them. They should also be concerned with the hierarchical sequence of their own courses. Too frequently we hear of students who must take two or three courses as prerequisite to one advanced level course, but when they get into the advanced level course, it takes off on a tangent of its own and never utilizes the knowledge which was prerequisite to entrance. This is difficult for the student to comprehend. To them it is obvious that a coordinated program is important and has not yet been derived in that particular situation. Some institutions are considering internship programs in the production of college faculty for biology — not just student assistants but persons who are farmed out to some two year or four year college for a year or two as a prerequisite for the granting of the final degree. This approach probably has many pitfalls but at the present time there are very strong vocal advocates for some increase in training potential faculty candidates.



Floor plan of the function floor of THE JOHN MARSHALL HOTEL



Floor plan of the mezzanine floor of THE JOHN MARSHALL HOTEL



Map showing approaches to The John Marshall Hotel in Richmond, VA.

The ASB

BULLETIN

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OFFICE OF THE PUBLICATIONS

July 1971



Terraced clear-cut, Bitterroot Valley, western Montana. Both terracing and clear-cutting are practiced throughout much of western United States as a means of exposing shade-free bare mineral soil in order to promote monocultural forestry for second generation growth. At this spot,

20,000 years of accumulated soil and its stored nutrients were removed in a single season. Regrowth by pioneering species such as the Douglas Fir is slow and natural reseeding almost impossible. (See page 117.)

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CONTENTS

The Recovery of Damaged Streams. — John Cairns, Jr., John S. Crossman, Kenneth L. Dickson, and Edwin E. Herricks	79
Restoration of a Terrestrial Environment — The Surface Mine. — Ronald D. Hill	107
Soil Destruction Associated with Forest Management and Prospects for Recovery in Geologic Time. — Robert R. Curry	117
Damaged Estuarine Ecosystems, Their Restoration and Recovery. — Thomas L. Linton and Arthur W. Cooper	129

A Symposium on the Recovery and Restoration of Damaged Ecosystems, Co-sponsored by the Association of Southeastern Biologists and the Center for Environmental Studies, Virginia Polytechnic Institute. The idea of this symposium was conceived by John Carpenter of the University of Kentucky some three years ago, and was finally brought to fruition through the combined efforts of many people throughout the Southeast. The four papers comprising the symposium were presented, by invitation, at the 32nd Annual Meeting of the Association of Southeastern Biologists, hosted by the University of Richmond, in April, 1971.

The Recovery of Damaged Streams

JOHN CAIRNS, JR.
JOHN S. CROSSMAN
KENNETH L. DICKSON
AND
EDWIN E. HERRICKS

Department of Biology
and
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From the four case 'history studies' presented it appears that the biological recovery of damaged rivers is a function of the physical, chemical, and biological characteristics of the receiving stream, the severity and duration of the stress, and the availability of undamaged areas to serve as sources for recolonizing organisms.

Short term acute stresses produced by the release of acidic or caustic materials into a receiving stream elicit a response pattern in the macroinvertebrate and fish communities typified by an immediate reduction in the number of specimens. When no residual toxicity is found and there are undamaged areas available to act as sources for recolonizing organisms a rapid recovery may be expected. Mill Creek had such a recovery when a small (100 foot) section of the creek was experimentally treated with acid immediately below an undamaged headwater area. By comparison the biological recovery of the Clinch River from the acute pH stresses has been somewhat slower due to the severity and the extent of the biological damage.

A long term acute stress and stresses from materials with residual toxicities produce a similar but slightly different response pattern. Just as in short term acute stress situations the general response pattern is an immediate reduc-

tion in both diversity (number of species) and density. However, with residual toxicities the macroinvertebrate organisms that survive the stress seem to be able to establish an interim type of community structure which lasts as long as the toxicity persists. For example, the Roanoke River had a residual toxicity from the ethyl benzene — cresote spill which was combined with a sedimentation problem and resulted in an atypical benthic community consisting of snails, nudge larvae, mayflies, and stoneflies. This community did not have representatives from the caddis fly, riffle beetle, and crayfish families. The macroinvertebrate community found under continuous acid stress in the Indian Creek study was also atypical consisting primarily of caddis flies and hellgrammites.

The rate of recolonization of damaged areas seems to be dependent upon 1) the distance an area is located from the site of the original spill and 2) the existence of undamaged tributaries. Those areas immediately below the site of the Clinch River spills were the first to show recovery. Reaches of the river further downstream were slower to recover. The rate of recovery is also faster below healthy tributaries as shown in the Indian Creek study.

Aquatic ecosystems have the ability to assimilate a certain amount of waste material and maintain near normal function. With the constant use and reuse of water from our natural aquatic systems by industries, agriculture, and municipalities the function may be altered or disrupted if the assimilative capacity is exceeded. The ability of a stream or river to assimilate wastes is governed by the capacity of the system to transform them before they reach deleterious levels. If an overload occurs, the system is disrupted, and the transforming capacity may be substantially reduced. Recovery may be rapid or slow depending upon a number of factors including: (1) severity and duration of the stress; (2) number and kinds of associated stresses; (3) recolonization of the area by useful aquatic organisms; and (4) residual effects upon non-biological units (e.g. substrate, etc.).

Industrial spills typically involve an abrupt release of a waste into a river. The waste usually passes downstream in a slug which lengthens as it proceeds due to mixing characteristics of the river and channel water. Exposure to peak concentration is usually short and will vary depending on velocity and other factors. This usually produces an acute stress which may eliminate most of the least tolerant organisms, but has considerably less effect upon the populations of moderately tolerant and tolerant organisms. Once the stress is removed or reduced the community will become reestablished through processes such as downstream drift and other methods of recolonization, although many of the species may be different from those originally present.

The assessment of biological damage caused by spills is in the early stages of development, and has been little more than cursory. It is usually restricted to observations of fish mortality and rarely includes detailed observations of the effects upon lower organisms. Observations may not begin until hours or even days after the spill, and are often carried out by untrained people. Interpretation of this information is difficult for many reasons, primary among these is the lack of information about conditions which existed before the spill and the rather random

and unplanned gathering of data by untrained observers after the spill.

To restore damaged ecosystems we must understand both the processes which lead to disruption of ecosystem function and processes which are involved in the restoration of structural and functional integrity. The purpose of this paper is to describe the response of complex aquatic communities to an acute stress and to describe the natural recovery processes which occur when the stress is reduced or removed. These processes must be understood before appropriate management practices can be developed for (1) gathering relevant and useful information when a spill occurs, and (2) restoring and rejuvenating damaged areas.

SHOCK ACIDIFICATION OF A HEALTHY STREAM

To simulate a short term stress which leaves no residual toxicity, an acute acid stress was produced in a portion of a small mountain stream. The effects of the acute stress and the subsequent recovery of the aquatic community were studied. Mill Creek, a tributary to the North Fork of the Roanoke River near Blacksburg, Virginia was used in this study. The total length of the stream is 2.5 miles, its average width is 3 to 8 feet, and its depth ranges from two feet in pools to 6 to 8 inches in the riffle areas. There are springs along most of its length which maintain a fairly constant discharge. The temperature varied between 15 and 17 degrees Celsius in the summer with a gradual decrease in the fall to a winter minimum of 7 degrees Celsius. The stream has a very diverse fauna including naturally reproducing brook trout. More than 100 macro-invertebrate taxa were identified during the course of the study.

Materials and Methods

To create two sites of comparable habitat, a 100-foot straight riffle section was divided in half along 60 feet of its length by imbedding in the stream bed corrugated roofing material covered on the lower quarter with plastic sheeting. The average width of this stream section was 6 to 8 feet with a typical depth over the riffles of 8

inches. To allow recovery from the effects of installation of the divider, the site was left untouched for four weeks prior to commencement of experimental work. When the stress was applied, the flow was alternately reduced on both sides of the divider for fifteen minutes (this increased the flow on the other side), and concentrated technical grade sulfuric acid was poured along the length of the experimental side during the reduced flow period. The pH in the treated section was reduced to well below 4.0 and maintained at that level for fifteen minutes. As water left the experimental section it was neutralized to pH 7.0 with sodium hydroxide.

Macro-invertebrate samples were collected in both treated (experimental) and reference (control) sections four weeks before as well as immediately before acid addition. Samples were also collected immediately after acid addition (day 0) and on day 2, 6, 13, 19, 28, and 34, following with additional samples at 14 to 60 day intervals. Each sample represents a composite of five Surber square foot bottom samples from both treated and reference sections on each date. Samples were collected in an upstream direction starting at the furthest downstream portion of the test site so that no area was

sampled twice or was downstream from an area where sampling had occurred. Each Surber sample on successive dates was collected from the vicinity of the prior collection ± 4 feet but never in the same area. Density was calculated as the average number of organisms in five square feet of bottom, diversity was calculated utilizing a method developed by Wilhm and Dorris 1968. Water chemistry was carried out with a Hach engineers' kit each time invertebrate collections were made.

Results

Figures 1 and 2 show that both treated and reference sections were stressed as a result of the experimental procedure. Density declined over 30% in both the treated and reference sections after acid addition. Since flow was alternately reduced and increased in both sections, the decline in density in the reference section was due either to the detrimental effects of low flow, or to the increased flow when water was diverted from the other side. The acid treated area, however, shows a more dramatic alteration with marked changes in both diversity and density. Two days after treatment, the community structure diversity index ($\bar{d}$) in the treated section

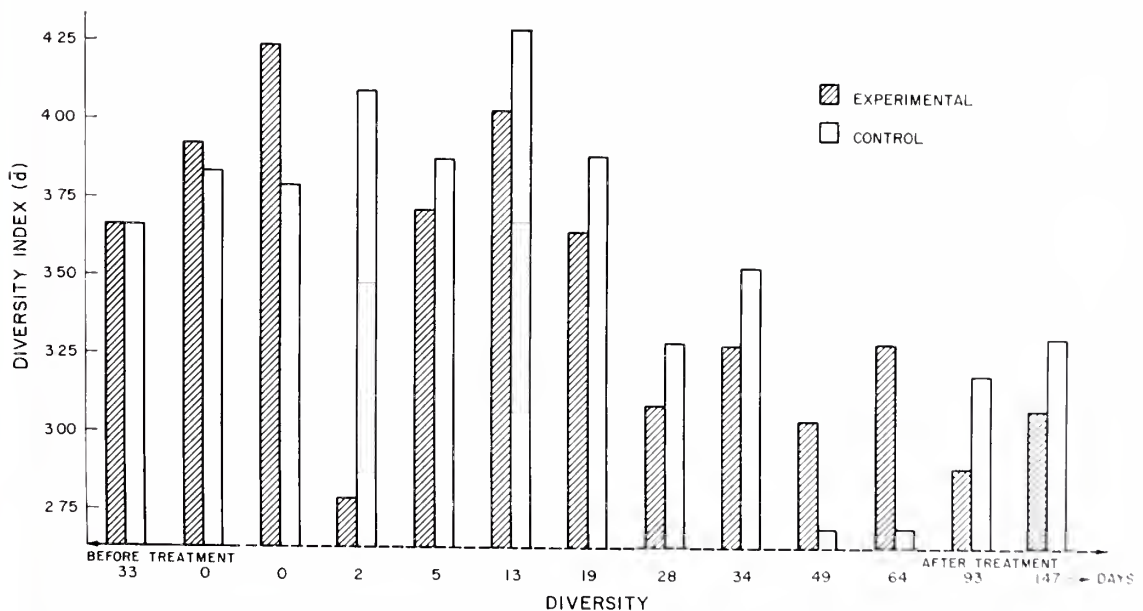


Figure 1. Diversity values obtained for the experimental and reference sections of Mill Creek.

was below 3.0 (Whilm and Dorris, 1968), indicating a stressed situation, while the $\bar{d}$ value for the reference section showed a health situation, above 4.0 (Figure 1). Density at this time in the treated section remained near 40 organisms/ft², while the reference section showed a large increase to over 200 organisms/ft². Recovery continued in the experimental section through day 19 when $\bar{d}$ and density values reached or exceeded the values recorded 33 days before the acid treatment. Restoration to a dynamic equilibrium occurred after day 19, with an average $\bar{d}$ value for days 28 — 147, of 3.0 and an average density of 130 organisms/ft².

Recovery in the reference section from the stress of low and high flow was very rapid. Two days after the experimental procedure was carried out the $\bar{d}$ value was greater than 4.0, and the density value was greater than 200 organisms/ft². The reference area was recolonized at a higher average density than the treated section, and diversity indices remained well above 3.0 through day 49. On day 49 the $\bar{d}$ value obtained, 2.69, indicated a stressed community. This decrease in $\bar{d}$ was accompanied by a decrease in density. The reference section showed a recovery pattern

of increasing diversity and density through day 147 when the experiment was terminated.

Discussion

Immediately after treatment the diversity index in the treated section showed a temporary rise while density remained low (Figure 1). This was probably due to a non-selective reduction of organisms in the treated community due to the low pH shock combined with an increase in downstream drift due to changes in flow (Minshall and Winger, 1968). Two days after treatment the $\bar{d}$ value was very low, 2.79, as was the density, 43 organisms/ft². The reference area showed little alteration in diversity and had a very high density, 205 organisms/ft² at this time. This difference was probably due to the destruction of food organisms and temporary changes in the habitat which made immediate recolonization of the treated section unsuitable. Some of the surviving species had striking increases in numbers of individuals on day 2, becoming dominant in the community. This dominance was reflected in the low diversity value obtained for this day. Five days after treatment the community structure had regained some of its original complexity. The $\bar{d}$ value for day 5 was above

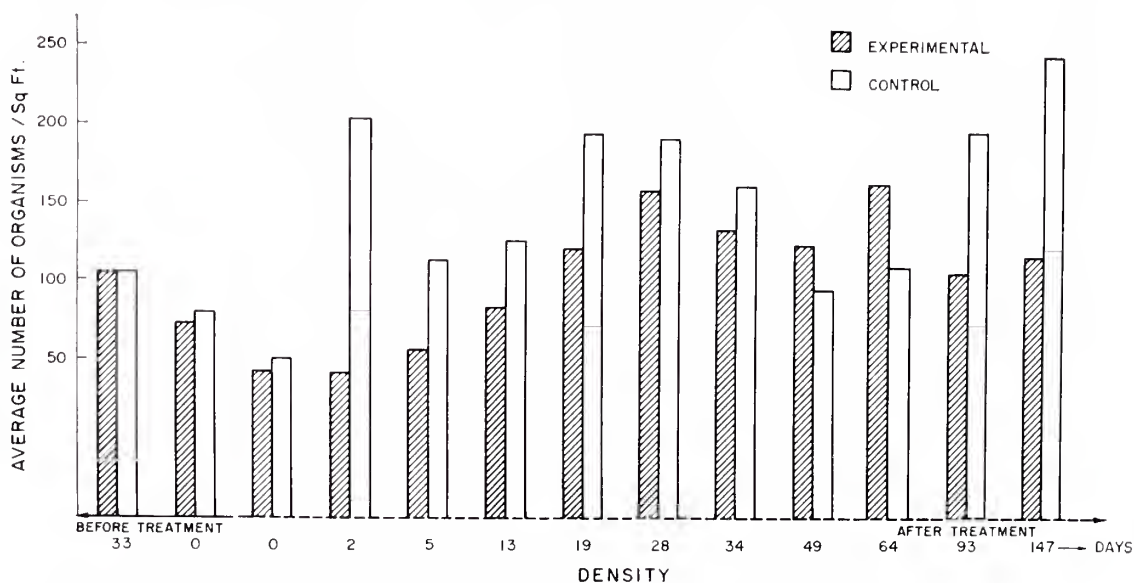


Figure 2. Density values obtained for the experimental and reference sections of Mill Creek

3.0, and density rose to 53 organisms/ft². During days 13 through 28 the community completely recovered, reestablishing its former level of complexity as evidenced by high diversity and density values. Decreases in $\bar{d}$ and density during the late stages of the experiment was undoubtedly due to a number of factors. The most important probably were fall emergence of adult insects and a low grade stress produced by high suspended solids loading (Cairns, 1967).

The effect of higher than normal sediment loading was noted in the reference section. Rainfall shortly before sampling on days 49 and 64 produced runoff with high suspended solids. Runoff from adjacent fields and a dirt road was channeled along the reference section by the divider. This load added to the light sediment load the stream carried during normal runoff situations produced a stress situation in the reference section (the two sides were otherwise similar). On day 49 the reference section had low values (Figure 2) and both $\bar{d}$ (2.69 reduced from 3.52) and density (95 organisms/ft² reduced from 166 organisms/ft²) when compared with the previous sample. Recovery from this stress was slow due to the residual effect of deposited sediment on the substrate.

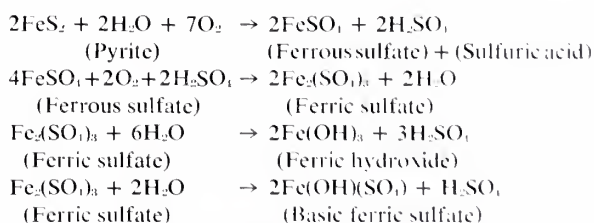
Conclusions

The results of the experimental acidification of Mill Creek provided information on the response of a stream fauna to an acute stress which left no residual toxicity. Community structure analyses ($\bar{d}$) and density values decreased after the pH shock and rose to pre-shock levels by day 28. The instability of the aquatic community after the pH shock was evidenced by a large difference in $\bar{d}$ values of the reference and experimental sections after treatment. This difference decreased through time and after day 28 the values for $\bar{d}$ and density oscillated around a mean value. The mechanism of restoration in the experimental section was probably the downstream drift of invertebrate species which recolonized the damaged area.

RECOVERY FROM ACID MINE DRAINAGE

Long term stresses produce effects which may severely alter the aquatic environment. Acid drainage from mining operations may persist for many years. Acid discharges have been noted since the late 1600's when they were observed in association with the first productive coal beds in the United States (Eavenson, 1942). A more complete description of the "sulphur water" was given by T. M. Harris in 1803: "Spring water issuing through fissures in the hills which are only masses of clay, is so impregnated with bituminous and sulphurous particles as to be frequently nauseous to the taste, and prejudicial to the health" (Eavenson, 1942). A 1962 report prepared for the Committee on Public Works of the House of Representatives on Acid Mine Drainage notes that there are 48,000 miles of streams and 29,000 surface acres of impoundments affected by acid discharges. A more recent appraisal of the mine drainage problem in Appalachia, made by the Appalachian Regional Commission (1967), noted there were 10,500 miles of streams in Appalachia which received a total of 6,000 tons of acidity per day. Total acid loads for all streams in the U.S. is estimated at 3.5 million tons/year. These acid discharges often result from mining operations when sulfuric minerals are oxidized in water producing acids and heavy metal hydroxides. Acid may be produced from the mining of lead, zinc, barite, manganese, gold, anthracite, and bituminous coal.

The acid drainage problem is localized in areas of moderate rainfall where solution and oxidation of the minerals pyritic, marcasites and pyrites (FeS) can take place and acid formation can occur.



The most intense area of acid drainage is in the Appalachian region coal fields in the eastern United States. The reaction is both chemical and biochemical in nature (Silverman, 1967). The

dissolution of one mole of the pyritic material leads to the production of four equivalents of acidity. It is this acidity associated with heavy metals and other byproducts of mining operations which may produce the high stress situations in the aquatic environment.

Coal production in the Appalachian region began in the late 1800's and reached a peak between 1910 and 1940. Two major methods are used in the mining of coal. Subsurface operations include deep shaft and drift mines while surface mining includes strip and auger mining. The effects of each type of mining operation on the environment depend largely on the geological and hydrological nature of the area and the physical and chemical characteristics of the coal seam to be mined. Deep shaft mines normally lie below the water table and have a constant supply of water which put minerals into solution. When this water comes to the surface, or in contact with air in the mine, the pyritic materials are rapidly oxidized producing large amounts of acid. Active deep mining operations usually control the water level in the shaft, but abandoned mines soon fill up with water and can produce severe drainage problems. It is estimated that approximately 75% of the total acid production has its source in subsurface mining operations.

The effect of surface mining on the environment are much more noticeable. Of the total of 3.2 million acres disturbed by surface mining operations in the United States, 41% are due to coal mining operations, and 62% of these operations occur east of the Mississippi River (USDI 1967). Strip mining operations normally expose large areas of land to erosion, and great quantities of pyritic materials to oxidation. The pyritic materials are usually found in slag and gob piles, byproducts of surface coal mining, and are porous, allowing free circulation of water and air within the pile, thus both active and abandoned mines produce acid discharges. It is estimated that approximately 40% of the acid drainages are from active mines, and of the remaining 60%, 35% is attributed to abandoned shaft and drift mines, and 25% to abandoned surface mines.

Acid mine drainage is typified by low pH water, high hardness, suspended solids and dissolved

TABLE 1. — Criteria for determining acid mine drainage.

pH	less than 6.0
Acidity	greater than 3 mg/l
Alkalinity	normally 0
Alkalinity/Acidity	less than 1.0
Fe	greater than 0.5 mg/l
SO ₄	greater than 250 mg/l
Total Suspended Solids	greater than 250 mg/l
Total Dissolved Solids	greater than 500 mg/l
Total Hardness	greater than 250 mg/l

solids such as Fe and SO₄. The criteria for determination of acid discharges are contained in Table 1. As previously described, the oxidation of pyritic materials produces large quantities of sulfates. Sulfates are usually present in low concentrations in nature (less than 20 ppm) and are found in high concentrations in acid mine discharges. Other elements of acid discharges tend to precipitate or plate out of solution while sulfate remains inert and detectable. This makes sulfate the best trace substance to identify mine discharges. The low pH conditions present in most mine discharges increase the solubility of heavy metals; mine discharges may also have high concentrations of zinc, copper, manganese, calcium, magnesium and arsenic. The increased solubilities of heavy metals in low pH situations may produce situations where synergistic or antagonistic reactions can occur which place further stress on the biological portion of the system.

Two streams were selected to determine the effects of acid mine drainage on the aquatic environment, and to study recovery of communities which were affected by acid discharges. Indian Creek, a tributary to the Youghieny River in S. Pennsylvania was selected because it had an isolated acid discharge and showed full recovery in a rather short distance. This stream was neutralized naturally by alkaline tributaries which diluted the mine discharges and neutralized the free acidity in the streams. A second site was selected which was artificially neutralized by a lime neutralization plant. Little Scrubgrass Creek in Venango County in northwestern Pennsylvania had approximately the same discharge as Indian Creek. In each case the regions had been fairly extensively studied by the Pennsylvania Department of Mines and Mineral Industries or the Fish Commission;

data from their reports were useful as background material.

Indian Creek

Indian Creek is located in Westmoreland and Fayette Counties in southwestern Pennsylvania (Figure 3). The stream flows southeast from its origin in Westmoreland County to its confluence with the Youghieny River in Fayette County. The total drainage area of the stream is 124 square miles of which 28% is in Westmoreland County and 72% in Fayette County. The total length of the stream is 27 miles with an average discharge of 85 cfs. Maximum discharge during the water year of 1966 was 256 cfs., with 2 cfs. the minimum discharge. Indian Creek flows along the Ligonier-Barnesboro Syncline in a shallow valley $\frac{1}{4}$ to $\frac{1}{2}$ mile wide. The surface rocks in the area are of Pennsylvania age made up of shales and weak sandstones, interbedded with coal beds. No major limestone formations exist in the Indian Creek Valley, but limestone exposures do occur in Laurel Hill to the east.

Five sampling stations were established on Indian Creek. Station 1 was located 200 feet above the confluence of Indian Creek with Champion Run. Station 2 was located in the mouth of Champion Run. Station 3 was located .25 miles downstream from Champion Run. Station 4 was located 2.5 miles, and Station 5 was 8.5 miles downstream from Champion Run. All stations were ecologically similar. A station was comprised of a shallow riffle area with rock or gravel substrate with wooded banks of rather gentle slope. Each station was sampled in a similar manner with the exception of Station 2. Five Surber square foot bottom samples were made in a transect across the stream, and qualitative samples were collected with a Turtox 8" $\times$ 10" $\times$ 18" bottom net. Station 2 consisted of a shallow riffle covered heavily by a $\text{Fe}(\text{OH})_3$ flock. It was impossible to obtain a quantitative sample from this area so only a qualitative bottom net sample was taken. Samples were preserved in 70% alcohol and returned to the laboratory for analysis.

All samples were treated in the same manner and bottom fauna were floated from the bottom substrate in a 1.12 s.g. sugar solution, a modifica-

tion of the techniques by Anderson (1959). The organisms were then separated and identified to genus wherever possible. Species diversity was calculated by the technique developed by Wilhm and Dorris (1968). Density values were calculated as the average number of organisms per square foot, while the community diversity index included all organisms collected at a station.

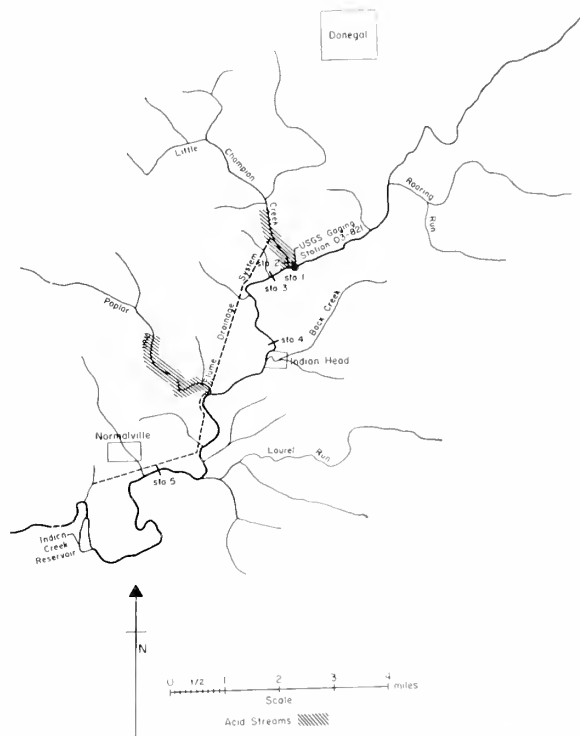


Figure 3. Indian Creek, Fayette County, Pa.

Results and Discussion

Water chemistry results from Indian Creek (Table 2) shows that Indian Creek normally has a high pH and alkalinity. After entrance of Champion Run (pH 3.9 and total acidity 94 ppm) the pH of Indian Creek is depressed one pH unit, and the alkalinity is severely reduced. At Station 3 the alkalinity/acidity relationship is 1, a marginally acid stream. Alkalinity is further reduced at Stations 4 and 5, but the alkalinity-acidity ratio is well above 1, indicating a healthy chemical situation.

The effect of the acid tributary on Indian Creek was very severe. The upstream reference station showed a community structured ($\bar{d}$) value slightly below 3.0, and a low density (Figure 4). When values are compared with a healthy mountain stream, i.e. Mill Creek (Figure 2), the density is very low. Station 2 showed an extremely low $\bar{d}$ value. Stations 3 and 4 showed diversity values below 2.0 and very low density values. Station 5 showed a diversity near 3.0 with density values greater than the reference station.

Station 1 was located behind a group of houses with several suspected sewage outfalls observed in the bank. The $\bar{d}$ values at this station, below 3.0 are typical of a moderately stressed situation, and are probably due to the influence of sewage on the bottom community. Two genera of caddisflies made up over 50% of the number of organisms at this station with organisms intolerant to high organic enrichment found in moderate numbers. This indicates an enriched situation with pollution loads of moderate intensity. Station 2 was a combined organic enrichment and low pH stress situation. A total of 186 organisms were collected at this station, 185 *Tendipes* sp.

and 1 caddisfly larva. Stations 3 and 4 both further downstream of the acid discharge, showed $\bar{d}$ values below 2.0, indicating a highly stressed situation (Figure 5). Density was low at both stations, below 10 organisms/square foot.

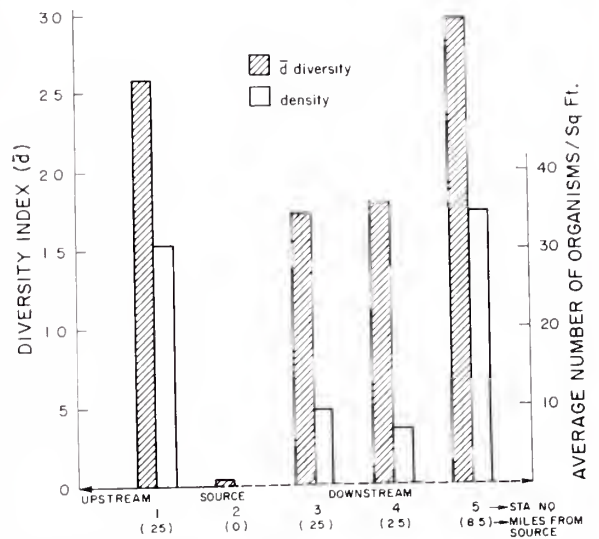


Figure 4. Density and diversity values obtained for stations on Indian Creek.

TABLE 2. — Representative water chemistry from Indian Creek.

Station Number:	1	2	3-LB	3-RB	4	5	I	II
Date	10/16/70	10/16/70	10/16/70	10/16/70	10/16/70	10/16/70	10/10/70	10/10/70
Free Acidity (Hot)	0	0	0	0	0	0	0	0
ppm as CaCO ₃ (Cold)	0	18	0	0	0	0	0	8
Total Acidity (Hot)	10	94	10	4	4	4	6	40
ppm as CaCO ₃ (Cold)	6	64	8	4	4	4	6	42
Total Hardness gpg as CaCO ₃	3.96	11.31	6.06	4.78	6.17	4.31	4.66	6.29
Calcium gpg as CaCO ₃	2.91	6.64	3.96	3.14	3.73	2.91	3.14	3.84
Fe ppm	0	1	0.66	0.45	0	0	NR	1.0
pH	7.8	3.9	6.4	6.8	6.8	RB-6.5, LB-6.7	7.6	below 3.7
Specific Conductance (in millimhos)	.155	4.1	.21	.17	.195	RB-.15, LB-.15 M-.155		
CO ₂ ppm	1.76	61.6	7.04	1.76	1.76	1.76	3.52	33.44
Phenolphthalein Alkalinity ppm as CaCO ₃	0	0	0	0	0	0	0	0
Methyl Purple Alkalinity ppm as CaCO ₃	40	0	10	24	16	18	12	0

Since no major tributaries enter Indian Creek between Champion Run and Station 4, the acid discharge may effectively reduce downstream drift if not block it completely. This section of the stream showed improved water quality, but is evidently dependent on airborne sources for recolonization. Because there are no tributaries to dilute the effects of the acid discharge, residual conditions in this region may make it unsuitable for recolonization of any type, or periodic increases in discharge from Champion Run may keep development of a healthy community in this region restricted. Station 5 had a $\bar{d}$ value near 3.0 (a healthy situation) with a density value greater than found at the reference station. Two major tributaries, Back Creek and Laurel Run enter Indian Creek between Station 4 and Station 5. These tributaries have the dual effect of further diluting the acid discharge, and acting as a source for recolonization in the downstream sections. Caddisfly larva still predominate at Station 5, but comprise less than 50% of the total number of organisms at the station. A large number of organisms intolerant to stress are present at this station including stoneflies and mayflies.

Little Scrubgrass Creek

Little Scrubgrass Creek is located in Venango County in northwestern Pennsylvania (Figure 5). The stream flows northeast to the Allegheny River. The total drainage area of the stream is approximately 15 square miles, and the total length of the stream is 8 miles. The stream lies in the Allegheny formation of Pennsylvania age. The stream flows through two rock types. The upstream portion is in the Conemaugh Formation consisting of soft sandy shales, a strong sandstone at the base, and interbedded with thin coals and limestone. The downstream portion flows through the Pottsville Formation predominated by sandstone with large shale lenses and thin seams of coal (Shaw and Munn, 1911). The upper portions of the stream have a low gradient, with the lower portions having a high gradient. The stream from Suttonmill drops more than 300 feet in approximately 2 miles to the confluence with the Allegheny River. In the headwaters of Little Scrub-

grass there are 11 deep mines, and 6 strip mining operations. The deep mines have been abandoned since 1950, and the strip mining operations have been sporadic since that time. The state of Pennsylvania has been active in reclamation of abandoned mines in the area. Most of the deep mines have been sealed, and backfilling operations have begun on many of the abandoned strip mines.

The history of reclamation procedures in Little Scrubgrass extends prior to 1949. In March of 1949 the pH of the stream was recorded to vary between 3.2 in the upper portions to 6.7 approximately five miles downstream from the present neutralization site. No fish-food organisms were found above the confluence of Little Scrubgrass with the North Fork of Little Scrubgrass, and the stream was classified as chemically suited for stocking below the entrance of the South Fork, but because of low food production it was regarded only as a temporary holding stream (Penn-



Figure 5. Map of Little Scrubgrass Creek, Venango County, Pa.

sylvania Fish Commission, unpublished). In 1966 the Department of Mines and Mineral Industries established an automatic lime neutralization plant in the headwaters of Little Scrubgrass (Maneval, 1968). The neutralization plant began operation in 1967 and other restoration procedures, including backfilling operations on the strip mine areas were undertaken at this time. The effect of this plant on the fish production of the stream was studied by the Pennsylvania Fish Commission, and several samples were made of fish populations and fish-food organisms (unpublished reports 1968, 1969). The initial effect of the plant was improvement of water quality; the pH above the plant was reported at 3.8 and that below the plant above 7.0 throughout the stream. The original liming operation produced a very thick $Al(OH)_3$ floc which covered the bottom of most of the stream, and made it unsuitable for the development of fish food organisms (Pennsylvania Fish Commission, unpublished). In 1969 the Department of Mines and Mineral Industries added a settling basin to the liming operation to remove the flocculent material. The effectiveness of this pond is noted in the present sampling. No floc was noted in the stream, and rich development of a macrobenthic community had occurred.

A total of 8 sampling stations were established on Little Scrubgrass. Stations were ecologically similar, with shallow riffle areas and good bank vegetation. Stations 1 and 2 were located above and below the liming plant respectively. The very low gradient in this region along with the high sedimentation due to upstream mining made quantitative sampling impossible. Bottom net samples were taken from diverse habitats to note the diversity in this region.

Sampling procedures were the same as described for Indian Creek. Because Little Scrubgrass is a small stream, the Surber samples were taken in an upstream direction rather than in a transect. Qualitative sampling involved sampling of both riffle and pool areas where they were adjoining.

Results and Discussion

The water quality in Little Scrubgrass is improved measurably by the lime neutralization plant. The upstream portions of the creek have a low pH and an alkalinity/acidity ratio of well below 1 indicating highly acid conditions. The lime neutralization process raises pH and improves the alkalinity/acidity ratio to well over 1 for the remainder of the stream. The pH of the stream

TABLE 3.—Representative water chemistry from Little Scrubgrass Creek.

Station Number:		1	2	3	4	5	6	7	8
Date		10/27/70	10/27/70	10/27/70	10/28/70	10/28/70	10/28/70	10/28/70	10/28/70
Free Acidity	(Hot)	0	0	0	0	0	0	0	0
ppm as $CaCO_3$	(Cold)	0	0	0	0	0	0	0	0
Total Acidity	(Hot)	26	0	4	4	4	2	2.5	4
ppm as $CaCO_3$	(Cold)	14	0	2	4	4	2	2	4
Total Hardness									
gpg as $CaCO_3$		17.4	19.82	15.39	12.94	6.64	9.67	9.56	9.21
Calcium									
gpg as $CaCO_3$		10.14	15.27	12.47	10.14	5.13	6.99	7.22	6.76
Fe									
ppm		0	0	0	0	0	0	.3-.4	0
pH		4.5	7.10	8.5	7.50	8.10	7.0	6.9	6.9
Specific Conductance									
(in millimhos)		4.15	4.05	2.8	3.1	.17	.27	.255	.255
CO_2		10.56	0	1.76	1.76	3.76	1.76	1.76	1.76
Phenolphthalein Alkalinity									
ppm as $CaCO_3$		0	24	0	0	0	0	0	0
Methyl Purple Alkalinity									
ppm as $CaCO_3$		4	42	34	38	50	34	34	36

remains near 7.0 and the alkalinity in downstream portions of the stream is very high (Table 2).

The effects of the limer on the aquatic organisms of the stream were also very beneficial. Station 1 upstream from the limer had a community structure diversity index ($\bar{d}$) value near 2.0 indicating a stressed situation (Figure 6). Station 2 immediately below the limer had an increased $\bar{d}$ value although the number of organisms at this station was very low (Figure 8). Station 3 showed a very high $\bar{d}$ value, well above 3.0, but density was still very low. Station 4, located immediately above a very healthy tributary, had a $\bar{d}$ value lower than Station 3, but the density value increased and the total number of organisms at the station was more than twice that found at Station 3. Station 5 was located in a healthy tributary free from the effects of mine drainage. The community structure index ($\bar{d}$) value was near 3, and the density value was similar to those found in a healthy mountain stream (Figure 2). Station 6 had a high $\bar{d}$ value with density almost double that of Station 4 with an increase in the total number of organisms at the station. Stations 7 and 8 both

show decreased $\bar{d}$ values, and very low densities. The total number of organisms at Station 7 was greater than Station 8, but was approaching the values found at Station 3.

The effects of acid mine drainage on the organisms in Little Scrubgrass were not as severe as those found in Indian Creek. Station 1 was well vegetated, and the substrate was a loose silt deposited to a depth of 1.5 to 3.0 feet over the original substrate. The effects of vegetation and gentle water flow produced a community unlike other samples. The samples were dominated by the Neuropteran, *Sialis* sp. and the Dipteran *Tendipes* sp. These organisms are resistant to low pH (Katz, 1969). Station 2 had a very low number of organisms and a low diversity value. The installation of the settling pond created an artificial stream channel through a loose clay material. This artificial channel joined the original channel a short distance below the neutralization plant. It is suspected that this substrate was unsuitable for the development of a diverse bottom fauna. Station 3 was located in a short riffle immediately below a small pool area. The diversity value here was high although the density was very low. The

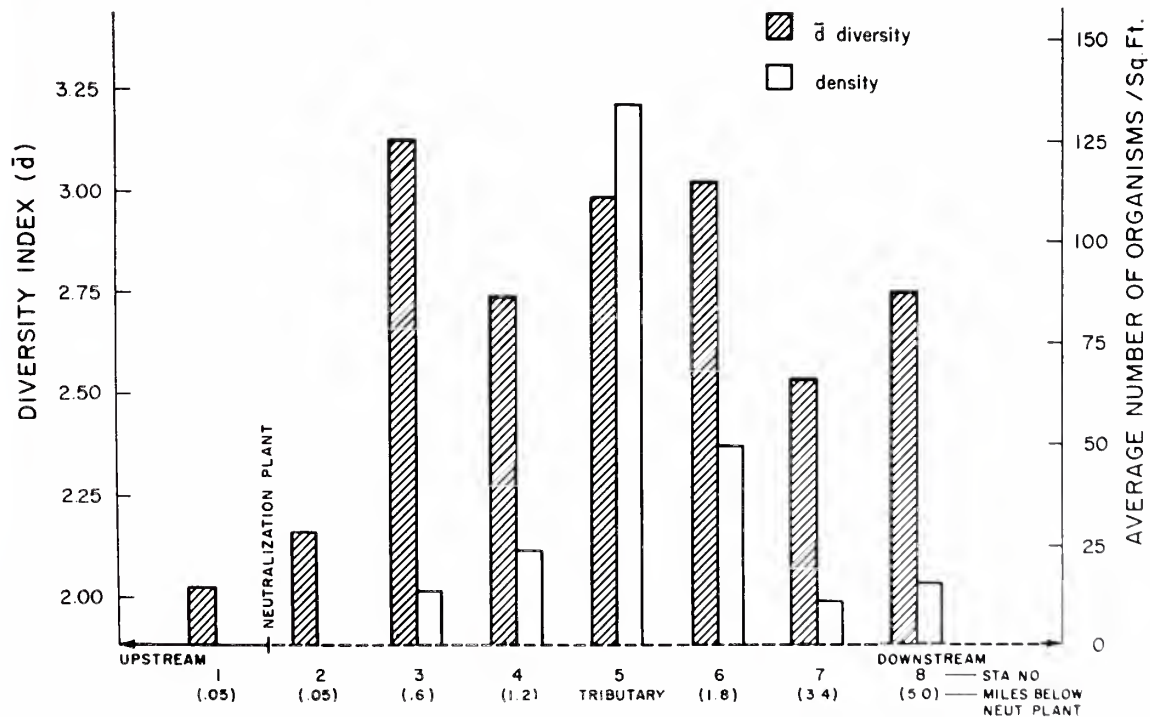


Figure 6. Density and diversity values obtained for stations on Little Scrubgrass Creek.

organisms which predominated were Dipterans, all typical of slow water habitats. Station 4 was located in a good riffle area immediately before the entrance of an unnamed tributary. The community structure evaluation at this station indicated a moderate stress, and the density value was low, but higher than Station 3. The tributary which entered Little Scrubgrass below Station 3 had little effect on the bottom fauna of the stream in this region. Station 5 was located on a very healthy stream. The community structure diversity index and density value were both very high, making this stream a good source for organisms which might recolonize downstream areas. Station 6 had a high $\bar{d}$ value and improved density over Station 4. This is probably due to the influence of the tributary at Station 5. There is a high correlation between the organisms which were dominate at Station 5 and those which were dominate at Station 6. This indicates that Station 5 did contribute large numbers of colonizing organisms which improved the bottom community of Station 6. Station 7 was located at the beginning of the high gradient area near a small community. The North Fork is dammed immediately above its confluence with Little Scrubgrass, and the South Fork shows evidence of acid discharges. The riffle area here was predominantly small boulders and rubble with some gravel. The combination of unsuitable substrate, possible sewage addition, and additional acid discharges may have contributed to the decrease in diversity and density at this station. Station 8 was located in the high gradient area with a substrate similar to Station 7 although there was more gravel. The low $\bar{d}$ value and density value here may be due to substrate conditions but biological indicators give evidence of improved water quality since the community was dominated by the mayfly *Ephemera* sp. which is intolerant to high stress conditions.

BIOLOGICAL DAMAGE AND RECOVERY FROM AN ETHYL BENZENE — CREOSOTE SPILL

The effect of an abrupt release of acutely toxic material into a river is an immediate stress on the organisms in the river followed by dilution of the waste and eventual restoration of water quality.

A spill of this nature occurred October 10, 1970 at Salem, Virginia on the Roanoke River. Ethyl benzene mixed with creosote was spilled into the Roanoke River from a primary storage tank of the Koppers Company. Approximately 2,000 gallons of solvent escaped and entered an open cooling water ditch (100 gal/min) which flowed into the Roanoke River. Approximately 400 to 600 gallons of the solvent entered the river in a period of 1 to 2 hours. River flow at the time of the spill was 19,000 gal/min resulting in an estimated concentration of solvent at the point of discharge of 1,000 ppm. The subsequent fish kill was reported by the Virginia Water Pollution Control Board and a total of 13,281 fish were killed consisting of 7,979 rough fish and 5,302 sport fish. Initial estimates by the water control board indicated that biological damage extended for a distance of 7 miles below the plant's outfall.

The exact toxicity of the ethyl benzene-creosote mixture is not known. However, using static bioassays, Cairns and Scheier (1959) found that the 96 hour TL_m for *Lepomis macrochirus* (bluegill sunfish) was 10.0 ppm for creosol. Pickering and Henderson (1966) established the 96-hour TL_m for the bluegill using ethyl benzene, at 29 ppm under static conditions. The synergistic or antagonistic actions of these compounds, or their action with other compounds in the river could have altered the acute toxicity of the spilled material in the Roanoke River.

Sampling stations were selected above and below the site of the spill and were sampled for both fish and aquatic macroinvertebrates. Sampling was done between 6 and 10 days after the spill for aquatic invertebrates, and 9 to 11 days after the spill for fish. A follow-up bottom fauna and cursory fish survey was conducted April 1 and 2, 1971 (six months later) to determine the extent of recovery. All sites were selected for their ecological similarity, having shallow riffles with rock and gravel beds with heavily wooded banks. The sampling stations were as follows:

Reference Station 1 — Located 50 yards above Virginia Rt. 612 Bridge and one-half mile upstream from the spill site.

Reference Station 2 — Located adjacent to Koppers Plant and .03 miles upstream from the spill site.

Station 3—Located 0.5 miles below the site of the spill with access via Krogers Road.

Station 4—Located approximately 2.0 miles below the site of the spill with access via Duguid Road.

Station 5—Located 3.5 miles below Koppers with access via Mill Street.

Station 6—Located approximately 4.5 miles below Koppers with access via Union Street.

Station 7—Located approximately 6 miles below Koppers with access via Colorado Street.

Fish Survey

Fish were collected using a 10 foot $\times$ 4 foot seine of $\frac{1}{4}$ inch mesh. All ecologically distinct sections of the stream were searched for fish at each of the seven sampling stations.

Jordan published a list of fishes taken from several places in and near Salem, Virginia (1890: 120-124). Since then several collectors have sampled the river, including Raney and Ross. In 1952 they made a large and representative collection of the Roanoke River at the Route 11 crossing, on the Montgomery-Roanoke County line (V. P. I. & S. U. #506). There were 33 species in the collection, now preserved in the Cornell University Fish Collection at Ithaca, New York (Table 5). Jordan's results listed 28 species (Table 4). Four of the species obtained by Raney and Ross in 1952 were not recognized by Jordan, those marked with an asterisk. These collections are closely comparable and represented the former stream faunistic composition in the area under study.

Based on the survey of the Roanoke River conducted immediately after the spill the fish fauna appeared to be in a state of good health except for the portions of the river delimited by Stations 3 and 4 (Figure 7). A total of 26 species of fish were found at Station 1 with 20 species at Reference Station 2. Smallmouth bass, bluegills, and rock bass were present at the reference stations but were absent at Stations 3 and 4 downstream (Table 5). Six species of perches were present at Reference Station 1 but were absent at Reference Station 2. Their absence was probably due to the introduction of sediments from highway and construction projects located between the two stations. Stations 3 and 4 below the site of the spill had a paucity of fish with only four species

of fish (all minnows) being found at Station 3 and eight at Station 4 (Table 5).

At Station 5 approximately three and one-half miles below the Koppers Plant, 23 different species of fish were found making it comparable to the diversities found at the reference stations. Stations 6 and 7 were highly productive with diversities similar to those found at the reference stations. They also supported a greater biomass of fish than noted at the other stations. This appeared to be due to nutrient enrichment which resulted in stimulated algal growth.

Bottom Fauna Survey

Four Surber Square Foot Samples were taken in a transect across the Roanoke River at each sampling station to quantitatively determine the effects of the spill on the bottom fauna. A bottom net sample was also taken at each station for qualitative evaluation of species diversity. Bottom organisms were separated from the debris using a number 30 mesh sieve and preserved in 70% ethanol for enumeration and identification.

Based on the survey of the Roanoke River conducted October 19-21, 1970 the bottom fauna at Stations 3 and 4 were drastically reduced when compared to Reference Stations 1 and 2. Eighteen taxa of bottom fauna were found at Refer-

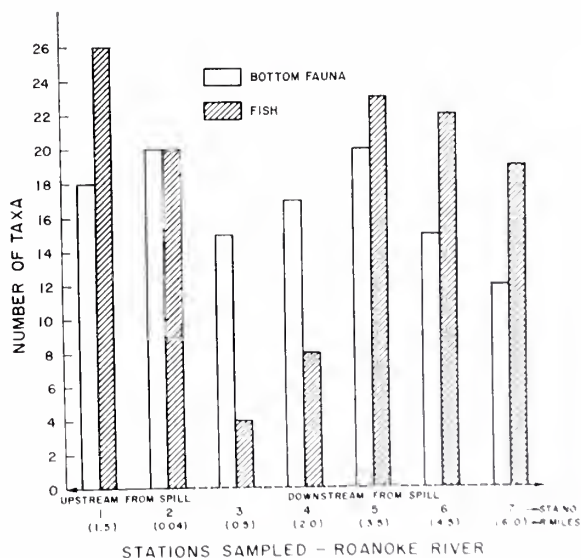


Figure 7. The number of bottom fauna and fish found at each sampling station.

TABLE 4. — Fishes taken by Jordan in 1888 and by Raney and Ross in 1952 from the upper Roanoke River in Montgomery and Roanoke Counties, Virginia.

	Jordan 1888	Raney & Ross 1952
Suckers, family Catostomidae.		
Hog sucker, <i>Hypentelium nigricans</i>	common	common
Roanoke hog sucker, <i>H. roanokense</i>		common*
Rustyside sucker, <i>Thoburnia rathoea</i>		several *
Common sucker, <i>Catostomus c. commersoni</i>	common	common
Black jumprock, <i>Moxostoma cervinum</i>	common	common
Bigeye jumprock, <i>M. aricomum</i>		common*
V-lip redhorse, <i>M. collapsum</i>		common
Suckermouth redhorse, <i>M. papillosum</i>	few	one
Minnows, family Cyprinidae.		
Rosyside dace, <i>Richardsonius funduloides</i>	scarce	
Bluehead chub, <i>Nocomis leptcephalus</i>	abundant	common
<i>Nocomis</i> sp.		several *
Blacknose dace, <i>Rhinichthys a. atratulus</i>	common	scarce
Cutlips minnow, <i>Exoglossum maxillingua</i>	common	common
Bluntnose minnow, <i>Pimephales notatus</i>		
Silvery minnow, <i>Hybognathus nuchalis regius</i>		one
Stoneroller minnow, <i>Campostoma anomalum michauxi</i>	common	several
Mountain redbelly dace, <i>Chrosomus oreas</i>	abundant	several
Mimic shiner, <i>Notropis volucellus</i>		common
Rosefin shiner, <i>Notropis a. ardens</i>	common	abundant
Crescent shiner, <i>Notropis cerasinus</i>	abundant	abundant
White shiner, <i>Notropis cornutus albeolus</i>	common	common
Satinfin minnow, <i>Notropis anastanus</i>	common	
Swallowtail shiner, <i>Notropis procne longiceps</i>	not rare	common
Spottail shiner, <i>Notropis hudsonius saldanus</i>		one
Catfishes, family Ictaluridae.		
Orangefin madtom, <i>Noturus gilberti</i>	present	several
Margined madtom, <i>Noturus insignis</i>	common	common
Sunfishes, family Centrarchidae.		
Smallmouth bass, <i>Micropterus d. dolomieu</i>	scarce	several
Redbreast sunfish, <i>Lepomis auritus</i>	common	common
Pumpkinseed, <i>Lepomis gibbosus</i>	scarce	
Roanoke rockbass, <i>Ambloplites rupestris cavifrons</i>	two	
Rockbass intergrades <i>A. r. rupestris</i> × <i>A. r. cavifrons</i>		several
Perches, family Percidae.		
Roanoke logperch, <i>Percina rex</i>	two	few
Piedmont darter, <i>Percina crassa roanoka</i>	common	common
Shield darter, <i>Percina peltata</i>	several	several
Fantail darter, <i>Etheostoma j. flabellare</i>	common	common
Riverweed darter, <i>Etheostoma podostemone</i>	common	common
Johnny darter, <i>Etheostoma nigrum nigrum</i>	one	several
Eels, family Anguillidae.		
Common eel, <i>Anguilla rostrata</i>	common	

* Species not recognized by Jordan.

ence Station 1 with 20 found at Reference Station 2 (Figure 7).

Construction of a sewer line introduced suspended solids between the two reference stations and may have been responsible for the decrease in density at Reference Station 2 (Figure 8). Mayflies, stoneflies, and caddisflies (pollution intolerant organisms) were present at the reference stations but were absent at Stations 3 and 4 (Table 6).

Stations 3 and 4 located below the site of the spill had a typical "pollution tolerant" community. Pollution tolerant snails and midge larvae made up the major part of the community. Fourteen taxa of bottom fauna were found at Station 3 with 17 found at Station 4. The average number of organisms/ft² was lower at these stations when compared to Reference Station 1, probably indicating an additive effect of sedimentation and toxicity from the spill.

TABLE 5.—The numbers of fishes collected at 7 stations (page 1) from the Roanoke River on October 19-21, 1970 in Roanoke County and Salem, Virginia.

Stations:	1	2	3	4	5	6	7
Suckers, family Catostomidae.							
Hog sucker, <i>Hypentelium nigricans</i>	3	20		2	7	11	14
Rustyside sucker, <i>Thoburnia hamiltoni</i>	12	10		2	1	14	7
Common sucker, <i>Catostomus c. commersoni</i>		1			1		
Black jumprock, <i>Moxostoma cervinum</i>	16	12		1		1	18
Bigeye jumprock, <i>Moxostoma ariommum</i>	2	8			2	6	6
V-lip redhorse, <i>Moxostoma collapsum</i>	4	4			6	1	2
Suckermouth redhorse, <i>Moxostoma papillosum</i>		1			1		
Minnows, family Cyprinidae.							
Bluntnose minnow, <i>Pimephales notatus</i>	36	15			3	4	
Bluehead chub, <i>Nocomis leptcephalus</i>	10	13	2	4	4	21	20
<i>Nocomis</i> sp.....		8				10	35
Cutlips minnow, <i>Exoglossum maxillingua</i>	1						
Silvery minnow, <i>Hybognathus nuchalis regius</i>	1						
Stoneroller minnow, <i>Campostoma anomalum</i> <i>michaui</i>	15	69			10	54	42
Rosefin shiner, <i>Notropis a. ardens</i>	86	151	3	15	8	144	142
Crescent shiner, <i>Notropis cerasinus</i>	126	77	19	47	15	64	29
White shiner, <i>Notropis cornutus albeohs</i>	125	8	4	46	109	50	76
Minnows, family Cyprinidae.							
Satinfin shiner, <i>Notropis analostanus</i>	1	1			1	7	1
Swallowtail shiner, <i>Notropis procne longiceps</i>						35	3
Spottail shiner, <i>Notropis hudsonius saludanus</i>		1			4		
Catfishes, family Ictaluridae.							
Orangefin madtom, <i>Noturus gilberti</i>	1						
Margined madtom, <i>Noturus insignis</i>	17	24		1	8	8	16
Sunfishes, family Centrarchidae.							
Smallmouth bass, <i>Micropterus d. dolomieu</i>	2					2	
Bluegill, <i>Lepomis m. macrochirus</i>		2			2		
Redbreast sunfish, <i>Lepomis auritus</i>	7	2			3	6	
Pumpkinseed, <i>Lepomis gibbosus</i>	1						
Rockbass intergrades, <i>Ambloplites r. rupestris</i> × <i>A. r. cavifrons</i>	1	2			1		1
Perches, family Percidae.							
Roanoke logperch, <i>Percina rex</i>	15				1	1	2
Piedmont darter, <i>Percina crassa</i>	58				35	88	61
Shield darter, <i>Percina peltata</i>	1						
Fantail darter, <i>Etheostoma f. flabellare</i>	7				1	66	12
Riverweed darter, <i>Etheostoma podostemone</i>	7				7	34	18
Johnny darter, <i>Etheostoma n. nigrum</i>	2					1	

Urbanization and the introduction of other industrial discharges into the Roanoke River influenced the character of the benthic communities at Stations 5, 6, and 7. *Cladophora*, a green algae was present at Stations 5, 6, and 7 indicating nutrient enrichment. Twenty taxa of bottom fauna were present at Station 5 with extremely numerous herbivorous caddisfly larvae and snails contributing to the high productivity of the area. Stations 6 and 7 supported a bottom fauna community typical of a nutrient enriched area.

A numerical diversity index evaluation ($\bar{d}$) (Wilhm and Dorris, 1968) indicated that Stations 1, 2, and 4 were healthy stations. All other stations qualified as mildly polluted (Figure 9). However, based on density, diversity, taxonomic information, and the diversity index evaluations, it appeared that the degradation of the Roanoke River due to the Koppers Company operations and/or spill was restricted to that area extending not more than three and one half miles below the plant.

Recovery Survey

A fish and bottom fauna survey was conducted in early April (approximately six months after the ethyl benzene-creosote spill) to document the extent of recovery of the damaged areas.

The results of the bottom fauna survey showed that riffle beetles which were present at Station 3, 6-10 days after the spill were absent six months later, possibly due to either a residual toxicity from the insoluble creosote or from continued introduction of suspended solids from construction (Table 6). Mayflies and stoneflies had recolonized the affected areas, indicating fairly good water quality since these organisms are generally considered "pollution intolerant" organisms.

A cursory fish survey (six months after the spill) of the upstream and downstream area around the Koppers Plant indicated that:

(1) The upstream area (Reference Station 1) still supported a healthy and diversified fish fauna. Approximately 28 species of fish were present including representatives from the sucker, minnow, catfish, sunfish, and perch families.

(2) The area immediately below the site of the spill supported a suppressed population of fish generally represented by the minnows. Apparently the minnows can invade more rapidly or are more resistant to any lingering toxicity or discharges from the Koppers Plant than are the other groups of fish.

Summary

(1) The effects of an acute stress from an industrial spill of ethyl benzene and creosote were

TABLE 6. — Number of bottom fauna genera in each family by stations.

Bottom Fauna	Station No.								
				Six Days After Spill				Six Months After Spill	
	1	2	3	4	5	6	7	1	3
	<i>Upstream</i>		<i>Downstream</i>				<i>Upstream</i>		<i>Downstream</i>
Beetles	4*	3	3	2	4	2	2	2	0
Caddisflies	3	3	0	2	2	1	1	2	0
Damselflies	0	0	1	0	0	0	1	2	0
Dobsonflies	1	1	1	2	2	2	1	1	1
Mayflies	3	5	0	3	2	2	3	5	5
Stoneflies	1	1	0	1	1	0	0	2	2
Trueflies	4	3	2	3	4	2	1	1	2
Crayfish	1	1	1	1	1	0	1	1	0
Scuds	0	0	0	0	0	0	1	0	0
Sowbugs	0	0	0	1	0	0	0	0	0
Flatworms	0	0	1	0	0	0	0	0	0
Mussels	1	1	0	0	1	0	0	0	0
Snails	1	1	3	2	2	2	1	1	1
Worms	1	1	1	1	1	1	1	0	0
Total Number	20	20	13	18	20	12	13	15	11

* Number of Genera

to decrease the diversity and density of both the fish and bottom fauna for approximately 3 miles below the site of the spill.

(2) A differential response to the stress was apparent with all major groups of fish, except the minnows, being entirely eliminated in the stressed area. Perhaps the minnows avoided the stress by swimming into small isolated tributaries or perhaps they rapidly reinvaded the area, or they may be more tolerant to this type of stress.

(3) Mayflies, stoneflies, caddisflies, and muscels did not survive the stress and were eliminated. However, mayflies and stoneflies were present six months later indicating improved water quality.

(4) Riffle beetles, trueflies, crayfish, some snails, and segmented worms were apparently able to survive the short term exposure to the ethyl benzene and creosote stress.

BIOLOGICAL DAMAGE AND RECOVERY OF THE CLINCH RIVER FOLLOWING ACUTE pH STRESSES

The Clinch River has been subjected to two major industrial spills which have resulted in fish kills and elimination of other aquatic organisms. To evaluate the effects of these spills and to study

the recovery processes benthic organisms and fish have been collected from the Clinch in southwestern Virginia and northeastern Tennessee for two years.

Description of the Clinch River

The Clinch River is a headwater tributary of the Tennessee River located in the ridge and valley region of southwestern Virginia and eastern Tennessee. As the main tributary of the Clinch River Basin, the Clinch drains 1,260 square miles of land in Virginia and extends for a distance of 148 river miles before it enters Tennessee (Tackett, 1963). The average discharge for the Clinch, at Speer's Ferry, Virginia, during the period of 1920 to 1960 was 1,578 c.f.s. with a maximum of 45,300 c.f.s. noted in January, 1957 and a minimum of 42 c.f.s. noted in September, 1939 (U.S. Geological Survey, 1960).

As the Clinch passes through the mountainous regions of Virginia it flows over exposed geologic formations of limestone and dolomite which range in age from early Cambrian to Pennsylvanian (Cooper, 1945). These formations contribute calcium bicarbonate to the water and raise the pH of the river to 8.0-8.5. Because of the high al-

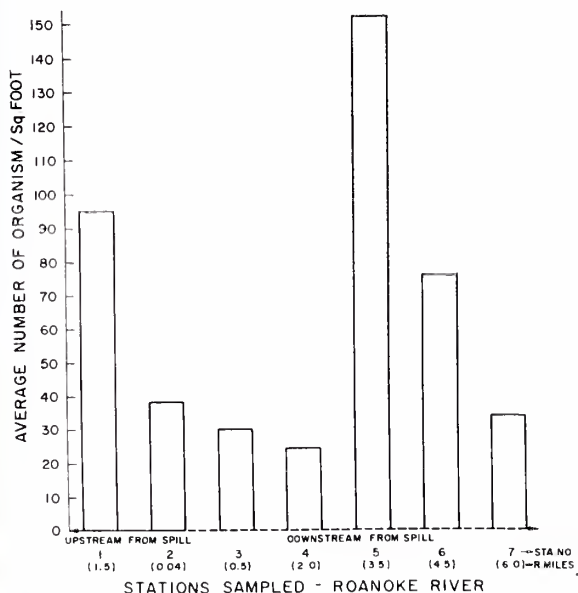


Figure 8. The average number of bottom fauna/square foot at each sampling station.

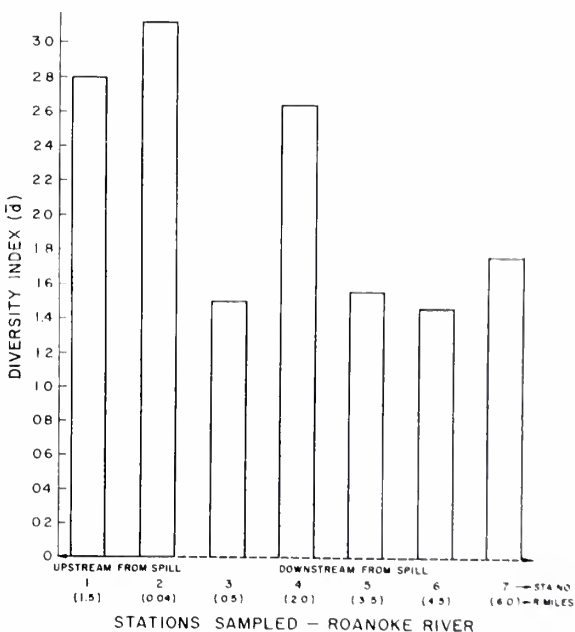


Figure 9. The diversity index $\bar{d}$ for bottom fauna at each sampling station.

kalinity, acid discharges from coal mines are readily neutralized. However, discharges from coal washing operations cause a major sedimentation problem in the Guest River and Dump's Creek, two of the larger tributaries of the Clinch.

1967 Fly Ash Pond Spill

The first fish kill occurred when the dike surrounding a fly ash holding pond collapsed at Appalachian Power Company's 700-megawatt steam power generating plant near Carbo, Virginia. At this power plant native coal is utilized to produce steam which is used in the production of electrical power. Because the coal has a high ash content, approximately 960 tons of fly ash is produced daily. To efficiently remove such large quantities of ash from the furnace hoppers, water from the Clinch River is mixed with the ash to form a slurry. This mixture is pumped to large settling lagoons where the ash settles and the supernatant is recycled. Because of recycling, free lime (CaO) in the fly ash reacts with water to form Ca(OH)_2 . This gradually raises the pH of the recirculating water and the water in the fly ash lagoons to extremely high pH values ranging from 12.0 to 12.7 (Anonymous, 1967b).

On June 1967 a 50-75 foot section of a dike surrounding one of the fly ash settling lagoons failed. Within less than an hour 400 acre feet (approximately 130 million gallons) poured into Dump's Creek which joins the Clinch River 0.5 miles downstream. This caustic slug equalled 40% of the daily flow of the Clinch at the time and resulted in blocking the normal flow for several minutes. It also raised the water level several feet and forced some of the waste approximately 0.5 miles upstream.

For four and one-half days following the spill the alkaline slug traveled downstream at a rate of approximately 0.85 miles an hour killing essentially all the fish in its path (Anonymous, 1967b). During this period 162,000 sport and rough fish were killed in 66 miles of the Clinch River in Virginia. An additional 54,600 sport and rough fish were killed in 24 river miles in Tennessee until the polluted mass was diluted, dispersed, and neutralized in the river by natural physical-chemical

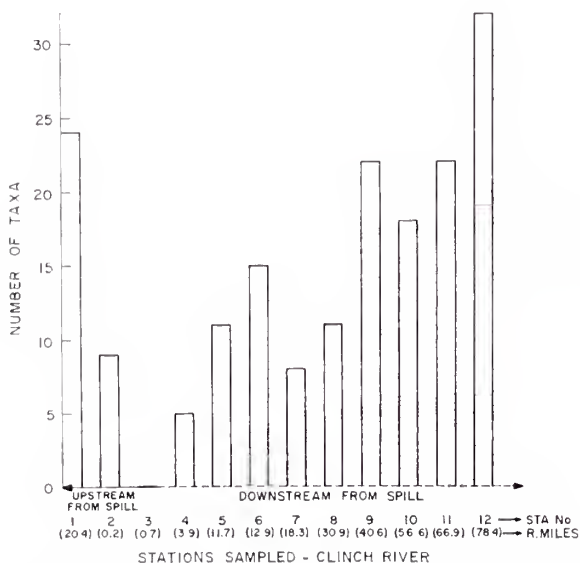


Figure 10. Number of taxa found at each station for June, 1967, bottom fauna survey.

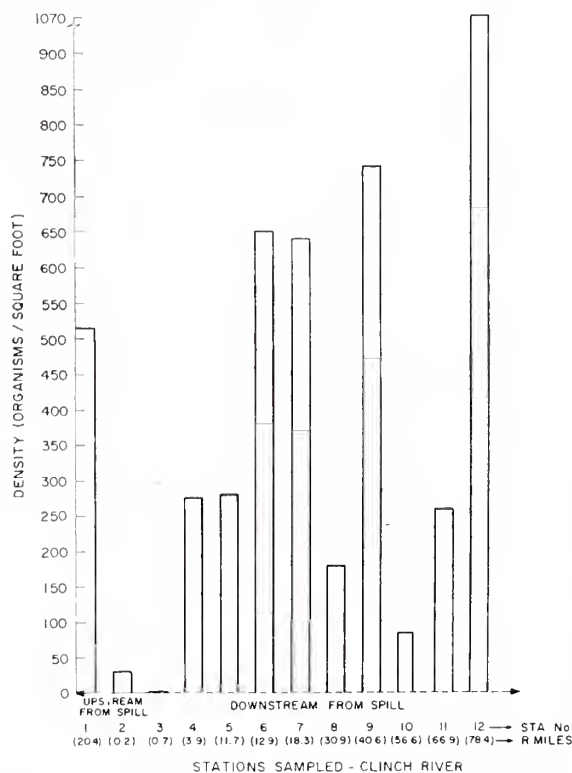


Figure 11. Density of organisms found at each station for June, 1967, bottom fauna survey.

forces. The chemical reactions involved in neutralization were:



In addition CO_2 from the atmosphere reacted with the water to form:



The lethal agent was reported to have been the high pH of the alkaline water which was composed of 90% hydroxide alkalinity and 10% carbonate alkalinity. A secondary effect which may have contributed to the biological damage was a depression in the dissolved oxygen concentration caused by the decaying organic matter (Anonymous, 1967b).

Ten days after the collapse of the dike the Virginia State Water Control Board conducted a bottom fauna survey at selected stations above and below the site of the spill to assess damage to the benthic fish food organisms (Anonymous, 1967a). They observed that:

1) Bottom dwelling fish food organisms appeared to have been completely eliminated for a distance of approximately 3 or 4 miles below the site of the spill (Figures 10, 11).

2) A drastic reduction in the number and kinds of bottom dwelling fish food organisms occurred in the Clinch River for 77 miles below the spill (Figures 10, 11).

3) Snails and mussels were eliminated for 11.5 miles below Carbo, Virginia.

4) The Virginia State Water Control Board, based on past experience, predicted that as far as total weight per square foot of stream bottom, the Clinch River would recover to its former productive capacity within three months after the spill. Both the Virginia and Tennessee Game Commissions believed that the stream organisms would appear in sufficient numbers for fish restocking in the fall of 1967 (Anonymous, 1967a).

Materials and Methods

During the summer and fall of 1969, a bottom fauna and fish survey of the Clinch River was conducted to study the extent of the biological recovery of the river following the 1967 fly ash spill. Particular emphasis was placed on studying the bottom fauna communities above and below the spill site because:

1) Benthic organisms are relatively sessile organisms and they cannot quickly avoid environmental stresses as fish often are able to do;

2) They have rather long and complex life histories and their presence or absence reflects the history of the environment;

3) Since they are members of the food web in an aquatic environment, their presence or absence directly affects fish populations;

4) Sampling techniques for bottom fauna are more reliable than techniques for fish; and

5) More biological information can be gained from studying this group of organisms per dollar invested than any other group.

The bottom fauna survey involved locating and sampling of twenty-one ecologically similar stations which extended from Blackford, Va. to Sneedville, Tenn., a distance of 120 river miles (Figure 12). Four stations were located above the site of the spill to serve as reference or control stations with which downstream stations could be compared. Twelve stations were located below the spill site to assess the river's recovery and to evaluate any contributing influences arising from industries, municipalities, or agricultural areas. Five additional stations were established on tributaries with pollution sources which could have effected the main river stations.

Sampling sites with comparable habitats and ecological similarity were selected so comparisons could be made between stations. After locating the stations, sampling was accomplished using a Turtlox 8" $\times$ 10" $\times$ 18" rectangular bottom net and a Surber square foot sampler. Care was taken that an equal collecting effort was made at each station. Each station was divided into three substations (left bank, right bank, and midchannel) and samples were taken from each substation with a bottom net since it had been observed that waste discharges were often restricted to certain portions of the river after discharge. Five Surber samples were taken along a transect through the riffle area for quantitative information. Immediately after collection, all samples were passed through a series of graded sieves (Tyler mesh Nos. 4, 10, and 35) and the organisms were removed and preserved in 70% ethanol for later identification and enumeration.

Fish samples were collected using a 10' $\times$ 4' seine of $\frac{1}{2}$ inch mesh. All specimens were preserved in formalin and stored in 70% alcohol in the Virginia Polytechnic Institute and State Uni-

versity museum. The collections were obtained at two stations above the spill site and at four stations below. Only the shallow areas and riffles were sampled.

Results and Discussion

The number of bottom fauna taxa found at each station are summarized in a histogram, Figure 13. A difference existed between upstream reference stations and stations immediately below the spill site for a distance of approximately 18 miles. At Reference Stations 1 through 4 the number of taxa varied between 48 and 54 while below the spill site there was a decrease at Station 7 to 43 taxa followed by an even more pronounced decrease at Station 8 to 33. This low value was followed by an increase in the number of species at the next three stations until at Station 11 there were 46 taxa, approximately the same number as were observed at the reference stations. At Station 13 a decrease in the number of species was found, followed by an increased number of species,

equal to reference station values, at the remaining downstream stations.

In Figure 14, a graph of density which includes all snail and freshwater mussel species, the difference between the upstream reference stations and stations below the spill site was even more pronounced. Densities for the reference stations ranged between 145.2 and 24.6 organisms per square foot. In contrast, densities at Stations 8-11 varied between 2.4 and 18.8 organisms per square foot with the highest density being found at Station 11, the station located furthest downstream. Station 13 showed a reduction in density which appeared to be due to unsuitable substrate conditions for benthic colonization and the influence of the tributary that flows into the Clinch River just above this station.

Figure 15, a graph of density which does not include snails and mussel species, indicated a difference between Reference Stations 1-4 and Stations 7-11. In addition, Figure 15 also indicated that:



Figure 12. Diagram of sampling locations on Clinch River and related tributaries.

1) There was a reduction in the densities at Stations 1-4 and 13-21 when compared to the same stations in Figure 4. This was caused by the exclusion of the snail and mussel data since these groups made up large portions of the invertebrate community at each station.

2) Densities were not affected by excluding snail and mussel species at Stations 7-11 because molluscs had not become reestablished after the spill. This may be the result of reduced susceptibility to downstream drift when compared to the drift found for insect larvae and other invertebrates, longer life cycles than found for most other aquatic invertebrates, and the lack of an aerial stage in their life cycles, all of which would affect their rate and extent of recolonization.

The differences found in diversities and densities at Stations 7-11 indicate a possible recovery pattern. This pattern would involve a combination of interrelated factors which would include the amount of damage at each station from the spill, differing rates of recolonization by different organisms, and a continuing mild environmental stress upon a limited portion of the aquatic ecosystem being studied.

The continuing environmental stress appears to have been caused by a discharge from the Appalachian Power Company's plant above Station 7.

This discharge channeled along the right bank for some distance before mixing and although it did not affect the overall diversity found at Station 7 it did appear to have an adverse effect upon aquatic organisms at downstream stations.

Community structure analyses of the bottom fauna collected at each of the sixteen sampling stations located on the Clinch River indicated that the bottom fauna community structures at stations below the spill site were similar to the control stations upstream (Table 7). In this study diversity ($\bar{d}$) was calculated for the left bank, right bank, and midchannel substations for all sixteen stations on the Clinch River using the following equation:

$$d = \sum (N_i/N) \log_2(N_i/N)$$

A complete explanation of this technique is given by Wilhm and Dorris (1968).

"Clean water" areas have been found by Wilhm and Dorris (1968) to have $\bar{d}$ values exceeding 3.0. Border line values such as were found at the right bank substation at Station 7, left bank substation at Stations 1 and 21, and the midchannel

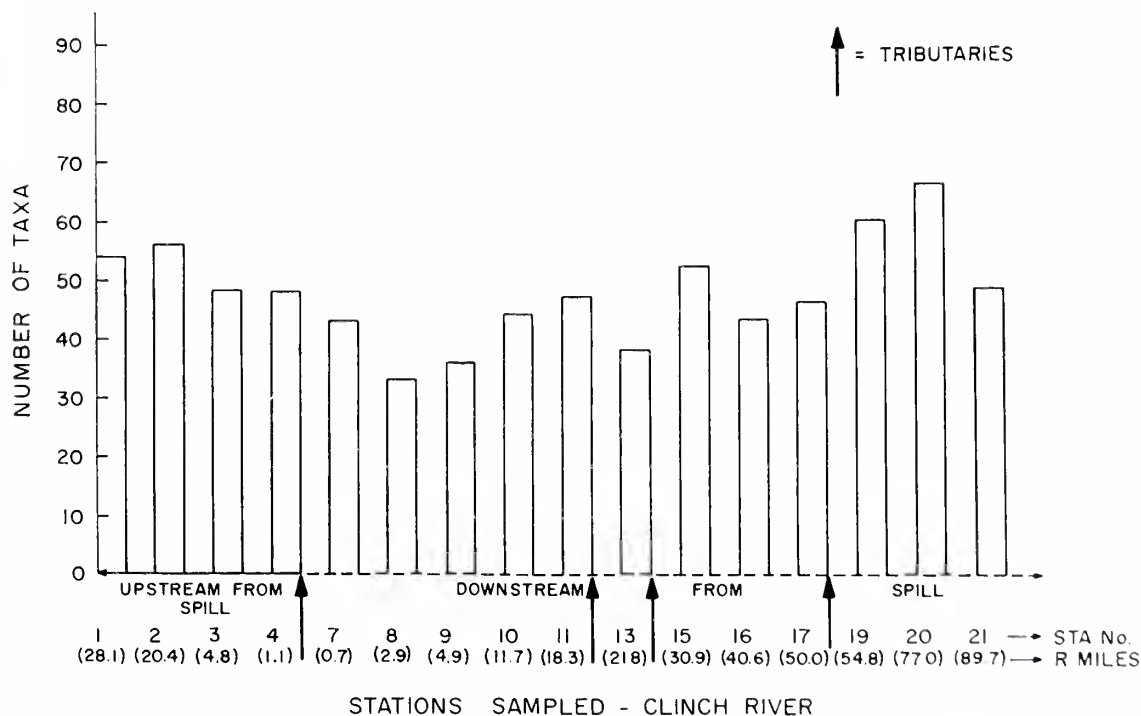


Figure 13. Number of taxa found at each station for 1969 bottom fauna survey.

TABLE 7. — Diversity values obtained with the index $\bar{d} = -\sum (Ni/N) \log_2 (Ni/N)$ for bottom fauna collected at stations sampled on the Clinch River.

Substations	Stations															
	Above Spill															
	1	2	3	4	7	8	9	10	11	13	15	16	17	19	20	21
Left Bank	2.97	3.65	3.75	3.79	4.21	4.35	3.76	3.29	3.61	3.81	3.95	3.85	3.67	4.19	4.19	2.98
Midchannel	3.22	3.33	3.27	3.93	3.28	3.64	2.88	3.19	4.17	3.64	3.26	3.30	2.48	3.41	2.26	3.37
Right Bank	3.32	3.86	3.94	4.03	2.92	4.06	4.01	4.06	3.87	4.01	3.86	3.31	3.79	3.54	4.03	3.27

substation at Stations 17 and 20 indicate areas of moderate pollution. However, it appears that the Clinch River has substantially recovered from the fly ash pond spill when the community structure of the bottom fauna is used as a criterion.

Results for the fish collections are given in Figures 16 and 17. Figure 16 gives the number of different fish species, made up mostly of minnows and darters, found at each station. Reference Stations 1 and 2 had 19 and 17 different species respectively, while Station 7 below the spill site had 11 species. This difference may be attributed to the decreased availability of fish food organ-

isms and/or the power plant's waste discharges. Further downstream at Station 9 the number of taxa had increased to the same level as observed at the upstream control stations but a drop at Station 11 to 2 taxa was found. Field observations made at the time of collection showed a large amount of silting at Station 11 which may have caused the reduction in diversity. Fish densities for each station, Figure 17, showed the same variations as were noted for the bottom fauna — a reduction in density immediately below the spill site followed by an increase the further downstream the samples were taken.

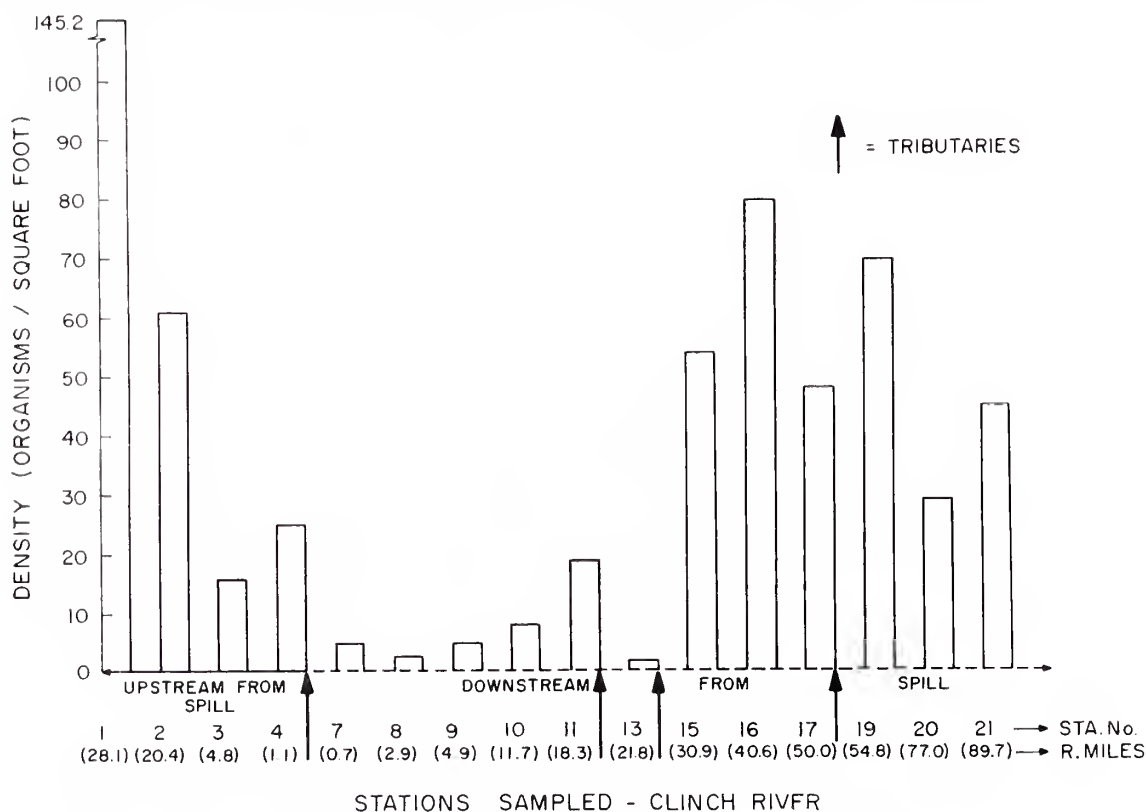


Figure 14. Density of organisms, including molluscs, at each station for 1969 survey.

Conclusions

From the preliminary survey, conducted two years after the alkaline fly ash pond spill, the following tentative conclusions seem justified:

1) Aquatic communities of bottom fauna that were completely eliminated below the power plant at Station 7 had recovered to the point where the number of different kinds of organisms found at this station were approximately the same as found at upstream reference stations unaffected by the spill.

2) Communities of benthic organisms at Station 8-11 indicate a linear recovery pattern; i.e., the further downstream the station is located the higher the density and diversity values.

3) Large portions of the communities at the reference stations and at stations 30 miles or further downstream from the plant consisted of molluscs. However, these aquatic invertebrates had not recovered at Station 7-11 below the site of the spill. This failure to recolonize appeared to be due to their inherent inability to reinvade and recolonize areas below the spill site as fast as aquatic insects.

4) Community structure analyses indicated that benthic communities below the site of the spill were similar to those found at stations above the spill site and were characteristic of "clean water" situations as defined by Wilhm and Dorris (1968).

5) Different species of minnows and darters had recolonized stations below the plant but had not attained the density levels found at upstream reference stations.

6) Two years after the spill, the Clinch River had not fully recovered. However, fish food organisms such as mayflies, stoneflies, hellgrammites, and midge larvae were present at all the areas affected by the spill and should support a productive sport fishery.

1970 Acid Spill

While undertaking the second year's bottom fauna survey a second industrial spill occurred at the Appalachian Power Plant on June 19, 1970, just after benthic samples had been collected at six stations above the plant and at four stations below. This spill involved the release of an un-

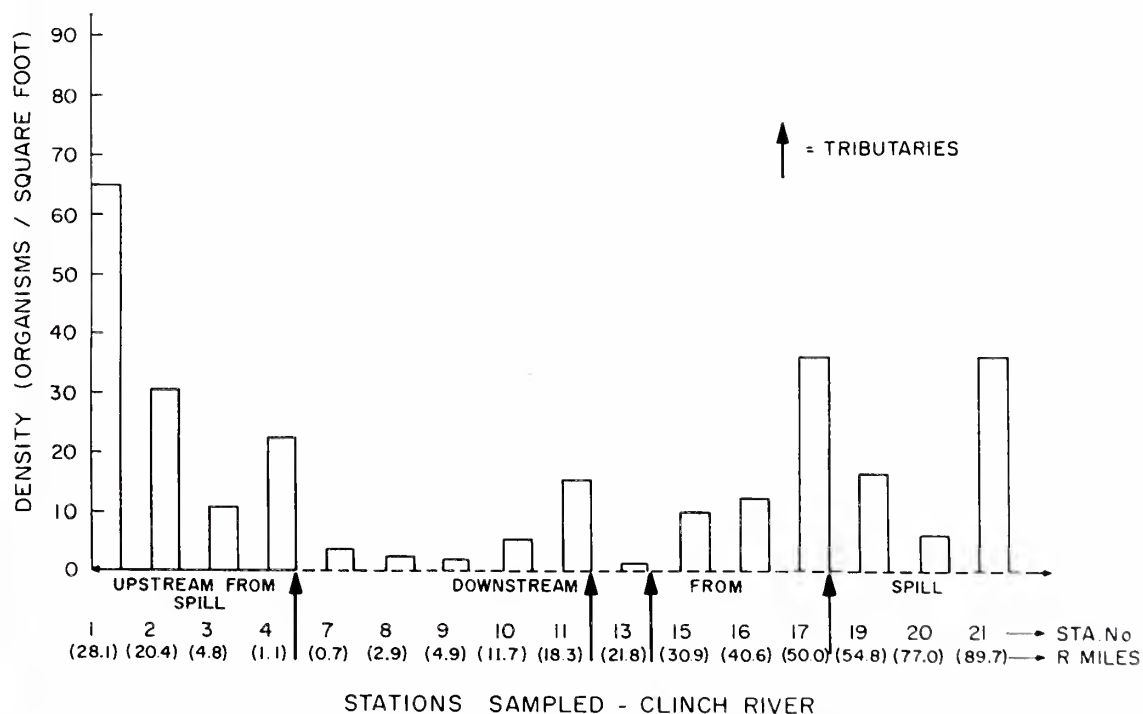


Figure 15. Density of organisms, excluding molluscs, at each station for 1969 survey.

determined amount of sulfuric acid which killed approximately 5,300 fish. Cursory examinations by representatives of the Virginia State Water Control Board indicated that stream damage began approximately one mile below the power plant and extended a distance of 13.5 river miles downstream to St. Paul, Virginia (Soukup, 1970).

Materials and Methods

Immediately after notification of the spill a series of cursory examinations were made on the bottom fauna, using the same collecting techniques as previously described, to determine the extent of the damaged area. These examinations were followed by thorough sampling of the stations in the affected area (as delimited by the cursory examinations) and were continued at two week intervals for the next sixty days. Additional samples were collected every four weeks at three unaffected stations during the same period. In all, seven ecologically comparable stations were included in the survey, consisting of one reference (control) station, four stations in the affected

area, and two delimiting stations. Station No. 4, located 1.1 river miles above the power plant, served as the upstream reference station with which the affected stations were compared. Stations Nos. 7, 8, 9, and 10, located below the spill site, were located to assess the effects of the spill and to follow the restoration of the damaged ecosystem. Two delimiting stations, Stations Nos. 11 and 13, were established 6.6 and 10.1 river miles below Station No. 10 to verify whether or not the effects of the spill were restricted to that section of the river from Carbo to St. Paul, Virginia.

Results

The total number of organisms found at each station were calculated and plotted (Figure 18). The data from Stations 4, 11, and 13 indicated that these stations were unaffected by the spill. However, seasonal variations did exist as evidenced by the increase in the number of organisms in July, the second sampling period, and the decrease in the number of organisms in August during the third collecting period. At Stations 7-10, the low pH shock caused an immediate de-

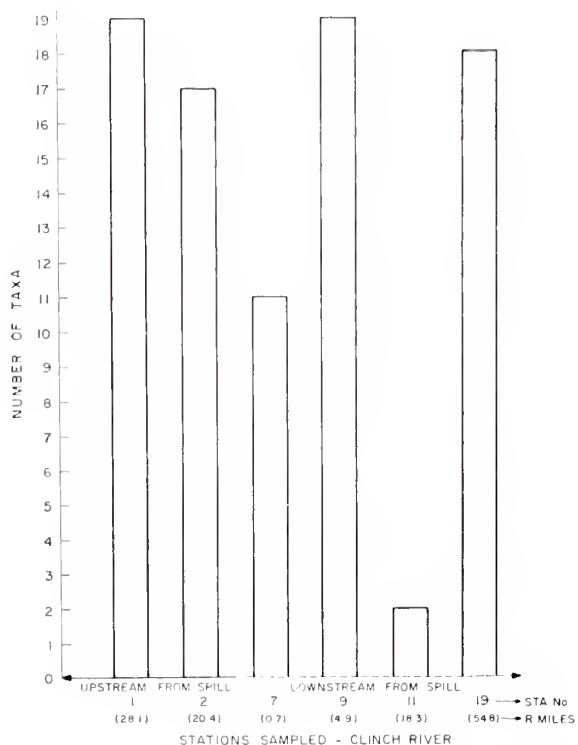
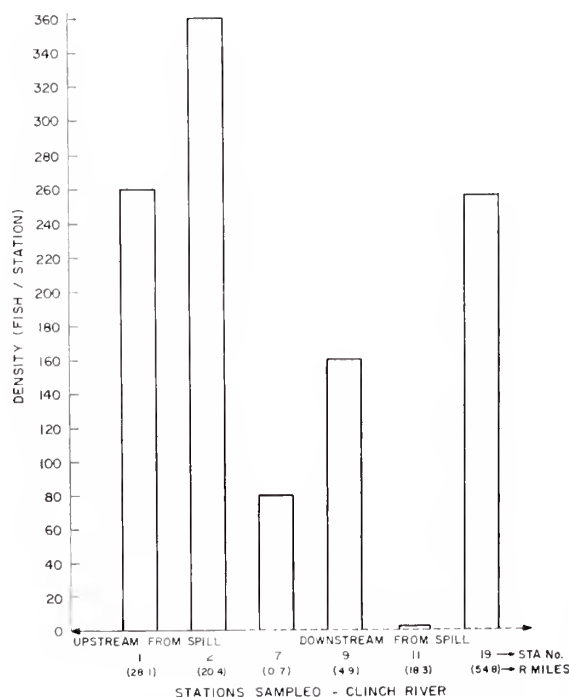


Figure 16. Number of fish taxa found at sampling stations for November, 1969, survey.



Number 17. Density of fish at each sampling station for November, 1969, survey.

crease in the number of organisms. This was the result of the elimination of all mayfly and mollusc species and reductions in the number of organisms per species for all other species except hellgrammites and adult beetles. The hellgrammite and adult beetle species appeared to have been unaffected by the pH shock.

Two weeks after the spill, the third sampling period, there were increases in the number of organisms/station at Stations 7-10. These increases were probably the result of population development by species that had survived the spill since new species were rarely found at any of the stations. By the fourth sampling period, four weeks after the spill, organisms which probably arrived by stream drift became more abundant making up between 4 and 10% of the total number of organisms. They would have made up a larger percentage had it not been for the three genera, *Hydropsyche* sp., *Cheumatopsyche* sp., and *Simulium* sp. Since these organisms are vertically distributed in the substrate (Coleman and Hynes, 1970) it was felt that their population increases were probably due to development of egg

masses and immature forms located deep in the substrate which were unaffected by the low pH shock. The eclosion of these immatures would account for the extremely high numerical values found for the fourth sampling period. After the rapid increase in the number of benthic organisms a stabilization period followed as values decreased and remained fairly stable during the fifth and sixth sampling periods.

Community structure analyses were run on the combined collections from each station using the technique developed by Wilhm and Dorris (1968). The results of this evaluation, expressed as diversity indexes ($\bar{d}$) were plotted to form a histogram (Figure 19). Stations sampled before the spill, denoted by an asterisk, had $\bar{d}$ values either above 3.0 or within 0.08 of that figure indicating "clean water" areas (Wilhm and Dorris, 1968). However, a moderately stressed situation was indicated since diversity indices were lower at Stations 8, 9, and 10 when compared to Reference Station No. 4. These reductions were probably the result of a combination of interrelated factors which may include stream damage from the previous fly ash pond spill and continued discharges from the

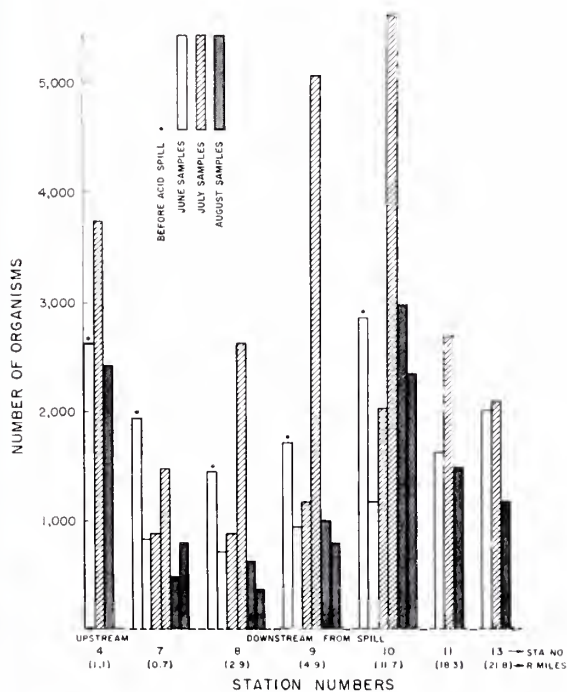


Figure 18. Number of organisms per station for June 19, 1970, acid spill.

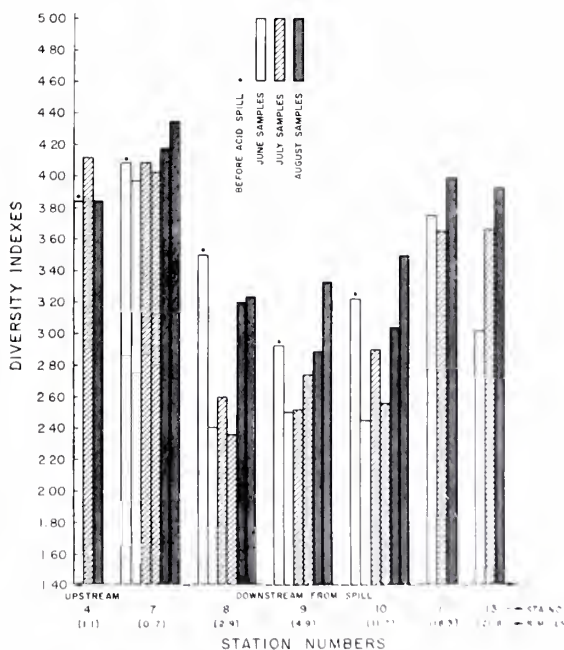


Figure 19. Diversity indexes for each station for the June 19, 1970, acid spill.

power plant. Station 7 did not show a decrease because effluents from the power plant were confined to the right side of the river and did not affect the station's overall community structure of aquatic organisms. Biological recovery from the previous alkaline spill also appeared to be further advanced at this station than at the Stations 8-10.

After the acid spill, diversity indices at Stations 8, 9, and 10 dropped to between 2.40 and 2.50 indicating that the community structure of the benthic organisms had been altered and were characteristic of streams with moderate pollution (Wilhm and Dorris, 1968). The reduction in $\bar{d}$ values was the result of decreased diversities (i.e., number of different species found) at each station. The number of taxa dropped from an average of 49 to 30 for the three stations, with the largest decrease occurring at Station 9 which had 48 taxa before the spill and 25 after.

Two weeks after the spill, the third sampling period, diversity values began to increase. This pattern of increased $\bar{d}$ values with time, continued at Station 9 during the fourth sampling period but was disrupted at Stations 8 and 10 where values decreased. At these stations disproportional population increases by *Simulium* sp., *Hydropsyche* sp., and *Cheumatopsyche* sp. altered the overall community structure and reduced diversity indices. By the fifth sampling, six weeks after the spill, these organisms were reduced in numbers and $\bar{d}$ values increased to above 3.0 or within 0.11 of that value showing that the invertebrate communities at each station were within the same "clean water" range as noted before the spill. Diversity values for sampling period six were all above 3.0 indicating stream recovery using community structure analyses.

Diversity values were also calculated for each substation sample and Surber sample at each station. These indices were tabulated along with the values previously mentioned for the combined collections, by station number and comparisons were made between values for each station and between the different stations (Table 8). Examination of indices showed very little difference between the numerical values of the combined samples and the substation and the Surber samples except at Stations 7 and 8. At these stations $\bar{d}$

values were consistently lower for the right bank substation because of the power plant's effluent which channeled along the right bank before becoming completely mixed.

Relative frequencies of organisms were calculated and plotted for each station, Figure 20. The frequency values were obtained by dividing the number of organisms of a group, tolerant or nontolerant, by the total number of organisms at the station. The tolerant and nontolerant classifications were determined by comparison of samples before and after the spill. If an organism was present in significant numbers before the spill and absent afterwards it was considered a nontolerant species and vice versa. In this graph the differences between Stations 8-10 and Reference Control Stations 4, 11, and 13 are more obvious. At Stations 4, 11, and 13 the frequencies for nontolerant species were between 30 and 60% during the entire sampling period. At stations 8-10 nontolerant species made up less than 25% of the total population before the acid spill because of the power plant's discharges and incomplete re-

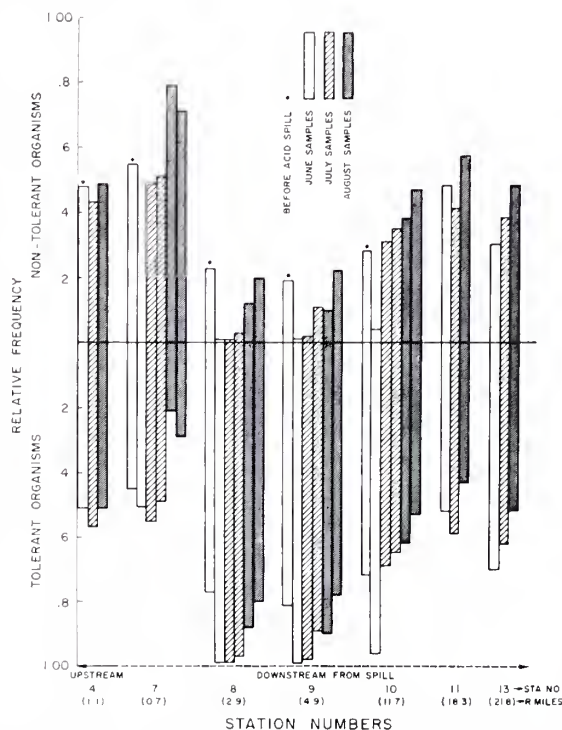


Figure 20. Relative frequencies per station for the June 19, 1970, acid spill.

covery from the alkaline spill. After the acid spill nontolerant organisms were almost completely eliminated at each station. Two weeks later, the third sampling period, they began to recover and continued to do so until the sixth sampling period when frequencies of 20, 22, and 50% were noted for the respective stations.

Conclusions

The following observations were made after comparing benthic samples collected before and after the June 19th acid spill.

(1) Aquatic communities of mayfly and mollusc species were completely eliminated by the low pH shock for a distance of 11.7 river miles.

Reductions in the number of individuals per species were also noted for all other species except hellgramites and beetles which appeared tolerant of the acid shock.

(2) Community structure analyses indicated that the stream invertebrate communities were altered by the acid spill and were characteristic of streams with moderate pollution.

(3) By the fifth sampling period, six weeks after the spill, diversity values were within the same clean water range as noted before the spill.

(4) The relative frequencies of organisms nontolerant of the pH shock were still increasing by the end of the sampling period.

(5) Sixty days after the acid spill the river had

TABLE 8.—Diversity values obtained with the index $\bar{d} = -(\sum Ni/N) \log_2(Ni/N)$ for bottom fauna collected after the June 19, 1970, acid spill on the Clinch River.

Station Number	Date	Collection	Left Bank	Midchannel	Right Bank	Surber
4	6-17-70	3.84	4.22	3.44	3.86	3.16
4	7-21-70	4.12	3.80	3.93	4.27	3.17
4	8-15-70	3.84	3.71	3.59	3.63	3.46
7	6-12-70	4.08	4.26	3.73	3.32	3.49
7	6-23-70	3.97	3.93	3.52	3.15	3.75
7	7-7-70	4.07	4.03	3.62	2.42	3.46
7	7-20-70	4.02	3.73	3.41	2.91	3.61
7	8-5-70	4.17	3.74	3.95	1.55	3.65
7	8-16-70	4.34	4.00	3.98	3.51	3.73
8	6-18-70	3.50	3.53	3.67	3.34	2.34
8	6-23-70	2.40	2.11	2.47	2.09	1.77
8	7-8-70	2.59	2.51	2.24	2.49	2.05
8	7-21-70	2.36	2.67	2.38	1.85	2.32
8	8-6-70	3.20	3.01	2.97	3.15	2.25
8	8-16-70	3.23	2.88	3.00	2.85	2.81
9	6-18-70	2.92	3.94	2.83	3.80	2.17
9	6-24-70	2.50	2.41	2.54	2.04	1.70
9	7-8-70	2.51	2.96	2.23	1.64	1.84
9	7-22-70	2.73	2.43	2.69	2.66	2.58
9	8-6-70	2.89	3.06	2.30	2.56	2.57
9	8-17-70	3.33	3.40	2.95	3.23	3.20
10	6-19-70	3.23	3.69	3.04	2.96	2.48
10	6-24-70	2.45	3.01	1.96	2.45	2.05
10	7-9-70	2.90	2.65	3.10	2.64	2.55
10	7-23-70	2.55	2.49	2.36	2.73	2.32
10	8-7-70	3.04	2.78	2.57	3.06	3.23
10	8-17-70	3.50	3.50	2.93	3.21	3.22
11	6-22-70	3.74	3.55	3.51	3.63	3.01
11	7-23-70	3.65	3.24	3.51	3.22	3.47
11	8-18-70	3.98	3.64	3.66	3.91	3.90
13	6-25-70	3.01	3.66	2.28	3.29	2.78
13	7-24-70	3.66	3.96	3.26	3.40	3.19
13	8-18-70	3.91	4.45	3.39	3.90	3.71

recovered to the point that representative species of aquatic insects found before the spill were present at all the affected stations. Mollusc species were slower to recolonize and had still not recovered by the end of the summer.

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Surface mining almost always causes damages to the environment. These damages manifest themselves in the form of degraded water quality, resulting in the water being unusable for domestic, industrial, and recreational uses, an aesthetic eye sore, decreased real estate value, and a waste land. However, surface mining does not have to produce these detriments. With proper preplanning, mining, water control, and reclamation as outlined in this paper, environmental damages can be held to a minimum. This is not to say that these procedures will be easy or inexpensive; however, if we wish to preserve our environment, a price must be paid.

Restoration of a Terrestrial Environment -- the Surface Mine

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The very concept of disturbing the surface of the earth by removing, turning over, and exposing it to remove the mineral wealth entombed therein, dictates that changes and possible damages will result to the environment. The damages can be permanent or held to a minimum and eventually restored to a condition approaching that existing before mining. A certain price in environmental damage usually must be paid to obtain the minerals required for our standard of living. The basic question is: What price are we willing to pay? We might outlaw certain types of surface mining resulting in an increase in cost of consumer products, or a reduction in the standard of living. A strict environmental control policy might produce the same effects.

In this paper, I will try to describe damages caused by surface mining (with emphasis on coal

mines), to outline techniques that can be utilized to hold damage to a minimum, and procedures to restore the land after surface mining has occurred.

As of 1965, according to the best estimates, excess of 3.2 million acres of land had been disturbed by surface mining in the United States. (Figure 1 illustrates land disturbed by commodities.) Open-pit mining accounted for about 35 percent and strip mining for 56 percent of the disturbed land. Two-thirds of the disturbed land (2.0 million acres) required some form of treatment to prevent environmental pollution (Figure 2). Approximately 800,000 of these acres requiring treatment were strip mined. ^{(1) *}

Water pollution associated with strip mines is due to mine drainage and siltation resulting from erosion. Mine drainage is usually characterized

Environmental Protection Agency, Water Quality Office Publication Number 14010—04/71.

* Numbers in parenthesis refer to references listed at the end of paper.

Some alkaline waters have high concentrations of ferrous iron and, upon oxidation and hydrolysis, form acid which lowers the pH and changes the drainage to the acid type. These types of discharges are more common to underground mines than surface mines.

Sedimentation and Erosion

The removal of the vegetation and the loosening and breaking up of the overburden by blasting, shovels, draglines, and dozers creates materials and conditions conducive to erosion. Curtis ⁽²⁾ and Collier, et al., ⁽³⁾ have documented the increased sediment and suspended solid loads from surface mined areas.

Sediment fills creek beds destroying fish habitat and creating flooding conditions. Suspended solids increase treatment cost for industrial and municipal supplies.

Erosion is influenced by the soil type, (sand, clay, salt, infiltration rate, and percolation rate), the climate (temperature and amount and type of rainfall), the topography (steepness, length of slope, land configuration and exposure), and the vegetation cover. Each of these factors should be considered in the planning, development and reclamation of a surface mine to prevent erosion.

Types of Surface Mines

To better appreciate the problems associated with strip mining, it is imperative that the striping operation be understood. Strip mining can be divided into two general types — area and contour.

Area strip mining is practiced on relatively flat terrain. A trench (called a cut) is made through the overburden** to expose the deposit of mineral or ore to be removed (Figure 3). The first cut is extended to the limits of the property or the deposit. The overburden from the first cut is placed on unmined land adjacent to the cut. The mineral or ore is then removed. Once the first cut is completed, a second cut is made parallel to the first; however, the overburden from the succeeding cuts is deposited in the cut just previously excavated. The deposited overburden is called spoil.** The final cut leaves an open trench

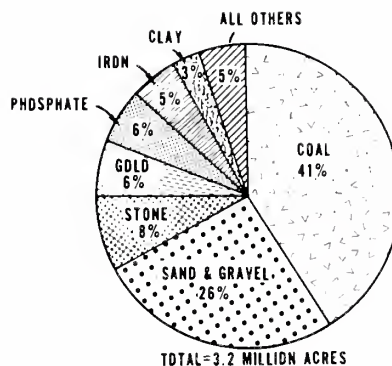


FIGURE 1 - PERCENTAGE OF LAND DISTURBED BY SURFACE MINING OF VARIOUS COMMODITIES AS OF JANUARY 1, 1965

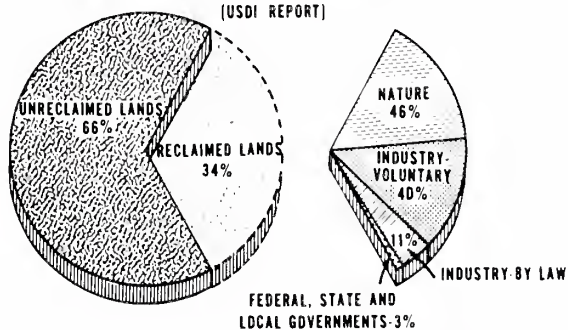


FIGURE 2 - STATUS OF LAND DISTURBED BY SURFACE MINING AS OF JANUARY 1, 1965 [USDI REPORT]

equal in depth to the thickness of the overburden and the mineral bed removed, bound on one side by the last spoil pile and on the other by the undisturbed highwall.** The final cut may be up to a mile or more from the starting point and the overburden from the cuts, unless graded or leveled, resembles the ridges of a gigantic washboard. Shovels (with capacities to 160 cubic yards), draglines (up to 220 cubic yards), and wheel excavations are used to remove the overburden. The nature of the spoil, the surface features, and characteristics depend to some extent upon the type of equipment used.

In general, the pollution from area mines is not as severe as that from contour mines. Silt from erosion can often be confined to the mining area. The overburden can be graded and revegetated to prevent erosion. Final cuts can be filled with water to prevent oxidation of the pyrite. The acid-producing material can be buried and thus prevented from being oxidized. A dragline or wheel

** Terms so marked are defined at the end of the paper.

excavator can perform this selective placement better than a shovel. A dragline, which sits on top of the overburden can selectively remove layers of overburden, placing the acid producing material on the bottom and the better material on top. Similarly, a wheel excavator has the ability to remove different layers. A shovel, on the other hand, sits in the cut and generally removes a section of overburden from the bottom to the top, thus mixing all of the various materials. In spite of these potentially beneficial actions, pollution does occur. Corbett and Agnew⁽⁵⁾ have shown that during periods of high rainfall, acid mine drainage can be flushed from spoil piles. Siltation of streams in area stripping regions is sometimes evident.

Contour stripping is practiced on rolling to very steep terrain. It consists of removing the overburden from the mineral seam, starting at the outcrop** and proceeding around the hillside (Figure 4). The cut appears as a contour line thus

the name. The overburden is deposited along the outer edge of the bench.** After the uncovered mineral seam is removed, successive cuts are made until the depth of the overburden becomes too great for economical retrieval of the ore. This type of mining creates a shelf or bench on the side of the hill. On the inside it is bordered by the highwall, ranging in height from a few feet to more than 100 feet, and on the outer side by a high ridge of spoil material. The spoil may be piled on the bench or pushed down the side of the hill. In either case, on steep slopes a more or less precipitous downslope is formed which is subject to severe erosion and landslides. Plass⁽¹⁰⁾ made a survey of eastern Kentucky and found that 12 percent of the outslope** area had failed (landslides). Because of the landslide problem, West Virginia has limited the bench width on steep slopes and forbids mining on slopes greater than 65 percent.⁽⁶⁾ Even with these precautions, landslides still occur. Many water problems arise

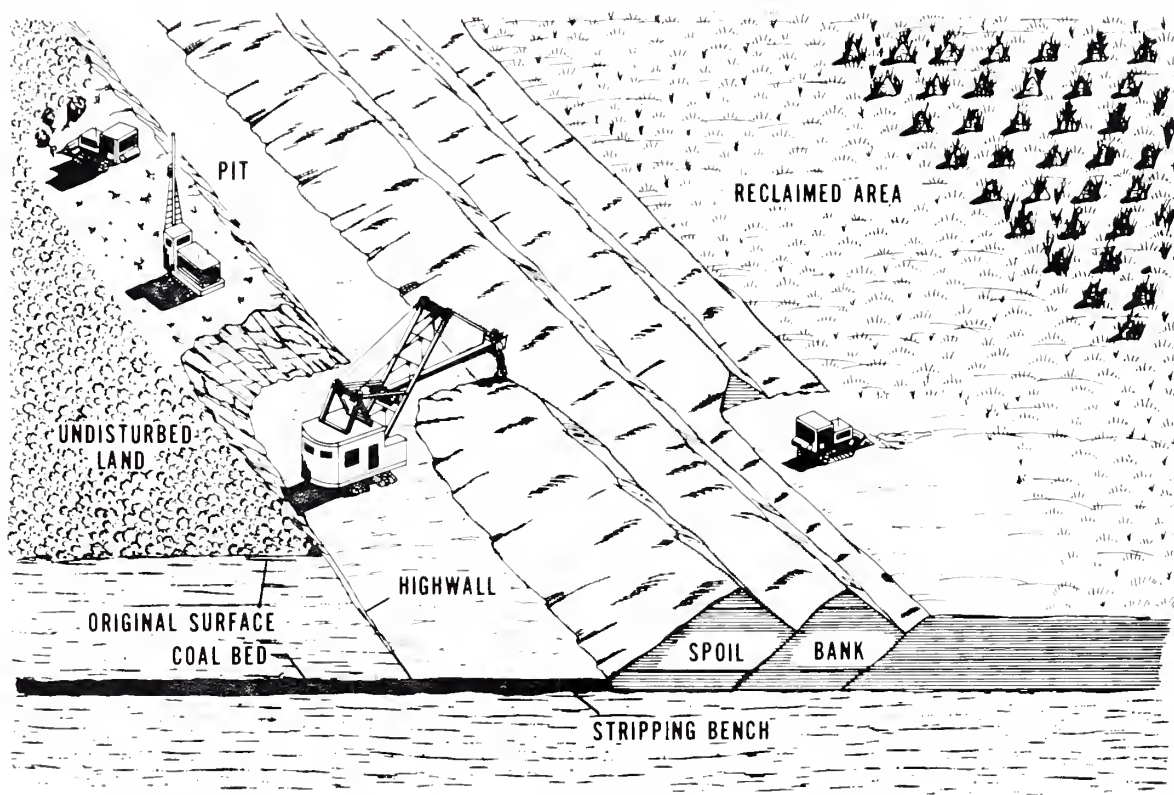


FIGURE 3
AREA STRIP MINING WITH CONCURRENT RECLAMATION

from this type of mining. The highwalls and spoil piles, because of their long, bare, steep, uninterrupted slopes are subject to severe erosion. Sediment coming off these slopes has been known to clog stream channels, cover highways, settle on cultivated land and kill crops, cover fish spawning beds, fill water courses, and thus, subject adjacent land to flooding, etc.

A study of watersheds draining to Beaver Creek, Kentucky ^{(3) (9)} showed that a partially stripped watershed (6.4 percent of area) had an average erosion rate of 5.9 tons per acre per year as compared to 0.7 tons per acre per year for an unmined area.

Even when spoil piles are graded, problems occur. If the grading is toward the highwall, the water may accumulate in an area of poor quality spoil, (i.e., a spoil high in pyritic material) and may therefore be degraded in quality. Where underground mines are located behind the highwalls, grading toward it often causes water to flow

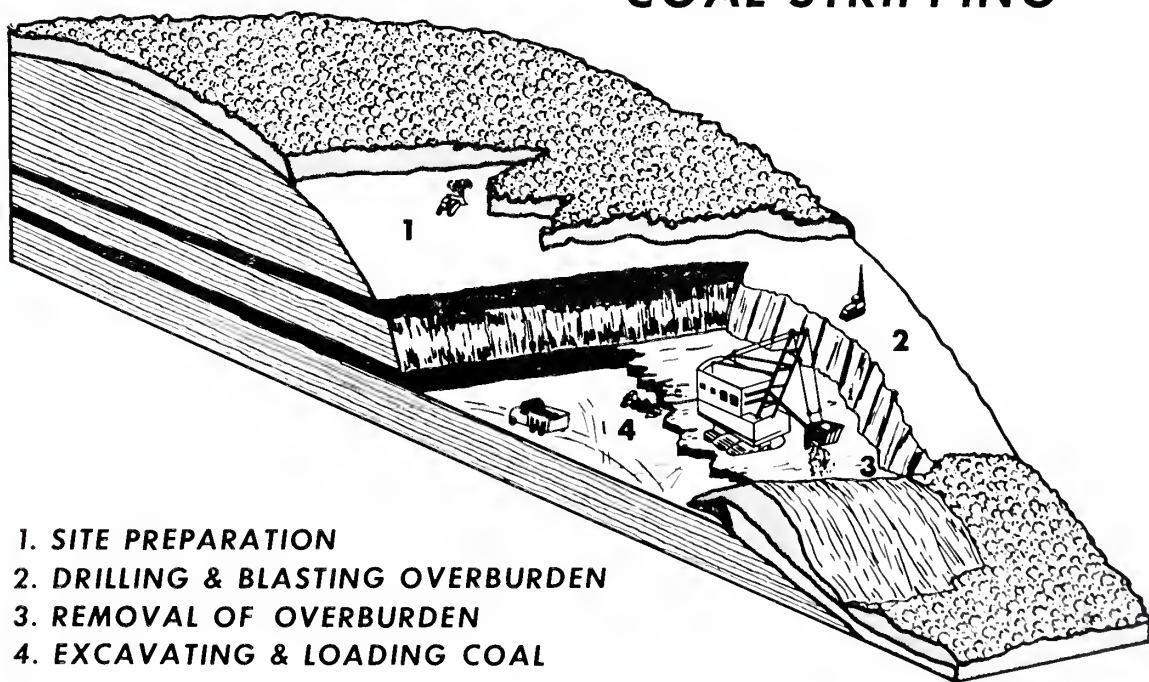
into the underground mine. This flow often flushes toxic material from the mine.

When spoil piles are graded away from the highwall, erosion may be as bad or worse, unless good water management practices are followed, such as diversion ditches across the top of the highwall, ditches or terraces across the slope to break the slope length and control structures to remove the water from the mining area.

Grading alone is not enough. A cover crop must be established to protect the bare surface and hold the surface in place. First consideration of a cover crop should be given to one that covers and holds the soil; a crop that will give a commercial return may also be possible. Neither planting nor grading alone is a satisfactory answer to the spoil bank problem, but a combination of the two can be very beneficial.

Another problem inherent in contour strip mining is that of toxic materials, i.e., pyrites, acid, soluble metals, etc., in the overburden. During

FIGURE 4 CONTOUR COAL STRIPPING



- 1. SITE PREPARATION**
- 2. DRILLING & BLASTING OVERBURDEN**
- 3. REMOVAL OF OVERBURDEN**
- 4. EXCAVATING & LOADING COAL**

the normal stripping operation, the high quality overburden near the surface is placed on the bottom of the spoil pile and then covered with low quality and often toxic overburden, leaving toxic material exposed to weathering and conversion to soluble acids and minerals which are carried away by water. However, for a small extra cost, the high quality overburden can be set aside to cover the toxic material after grading and/or during excavation. By this means, the toxic material is not subject to weathering and pollution can be reduced. Moreover, cover crops are difficult to establish on toxic overburdens and therefore, erosion damages occur. Erosion serves to prolong the mineral pollution problem by continuing to reveal new surfaces to weathering. However, when the toxic material is covered with a good material, cover crops can be grown to protect the surface.

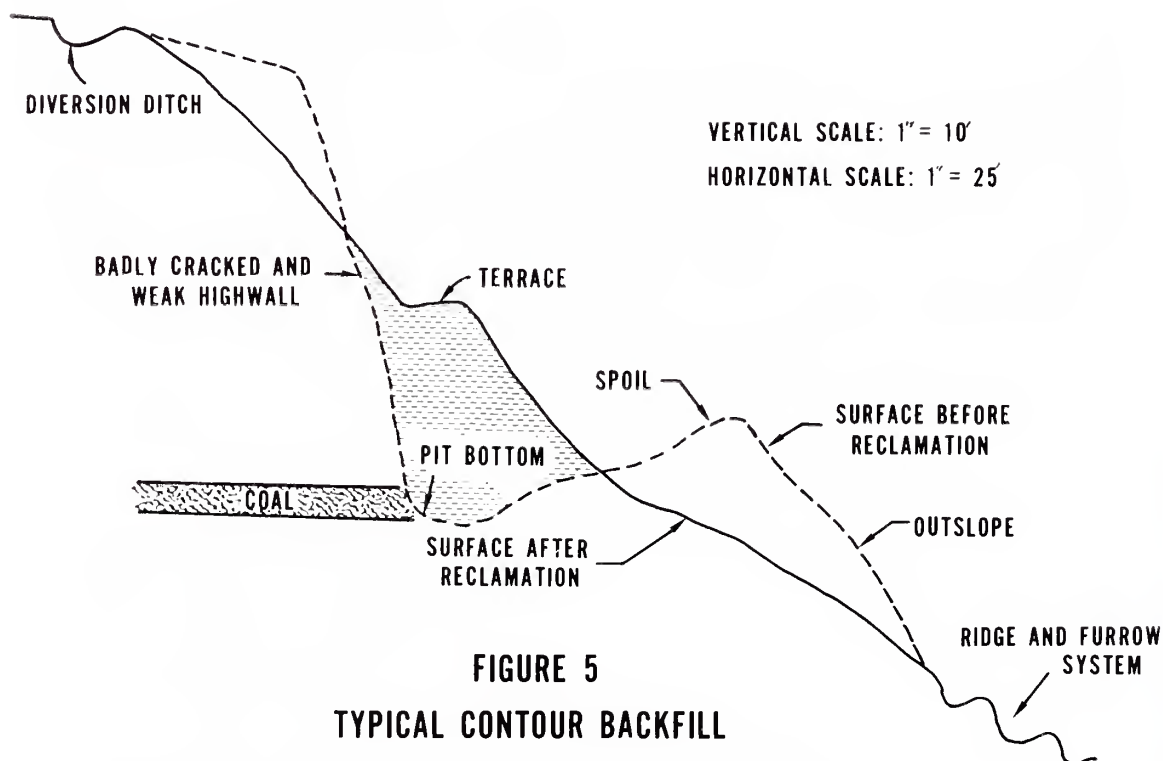
The final cut in a contour strip mine can also be troublesome. Materials adjacent to the ore seam are often toxic. A final cut left uncovered is a potential pollution source. When covered, the danger from this source of pollution is reduced or eliminated.

Highwalls can also lead to pollution problems. An unstable highwall that sloughs off can ruin the natural drainage in a strip area. Material falling off the highwall can dam up channels and thereby prolong the contact between water and toxic material or even force the water to seep through toxic spoil piles. Sloughing highwalls can open up new toxic material to weathering. Highwall problems such as these can often be overcome by grading the spoil back against the highwall and "knocking off" the top of the highwall.

Often in the excavation of a strip area, a natural drainageway is cut across. Unless the water is diverted around the mine workings, the water enters the mine area where it may become polluted. Problems such as this have been averted by not stripping the drainageway or by placing control structures such as drop boxes and concrete flumes.

Reclamation

If pollution from surface mines is to be held to a minimum, then reclamation must consist of a four prong attack: preplanning, proper mining,



water control during mining, and reclamation after mining.

Preplanning is the first step in reclamation. The operator should determine not only the quality and quantity of the deposit, but also the quality of the overburden material, the water pattern within the area (both surface and subsurface), the location of adjacent abandoned or inactive underground mines, the adjacent land and water uses, and the topography.

Analysis should be made of the overburden materials to determine their texture (sandy, clay, silty) and their chemical makeup (i.e., which strata are acid producers, have nutrient value for vegetation, and contain toxic material). This information should serve as a guide for planning the mining operation and water control. The less toxic, more fertile, and less acid producing materials should be selectively placed so that they will be on top when grading is performed. If the overburden contains acid producing strata, the installation of a system to treat any acid water should be developed. Water quality of discharges

from nearby mines in the same seam is a valuable reference to estimate water quality from the proposed operation. If the texture analysis indicates that the overburden is highly susceptible to erosion, special erosion control measures should be taken.

An evaluation of the surface and subsurface water pattern should lead to a sound water management plan. Mining can be planned around natural drainage ways or control structures designed. Interception of ground water can be avoided or control planned. The location of treatment facilities, such as sediment ponds, mechanical water control structures, and diversion ditches, can be determined. Quantity and quality of water can be estimated.

It is critical that all efforts be made to locate underground mines adjacent to the surface mines. Cutting into abandoned or inactive underground mines can result in the discharge of large volumes of polluted water stored in underground mines. The resultant continued underground discharges into surface mining works during and following

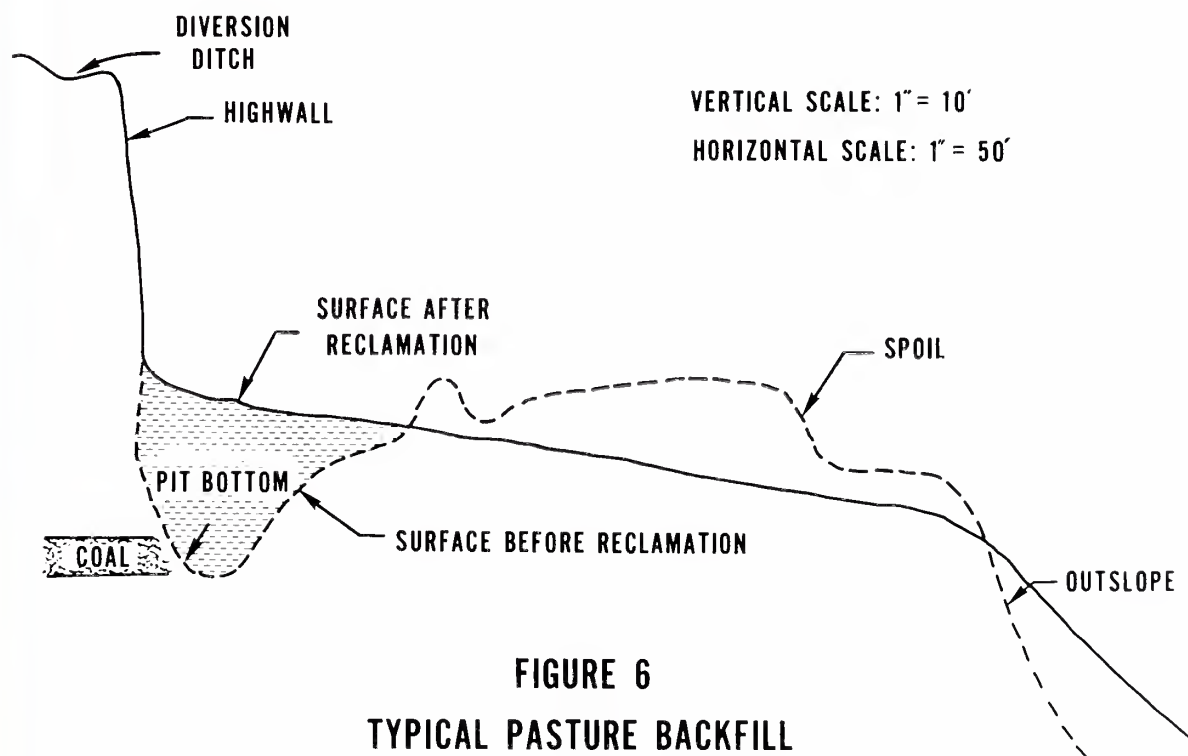


FIGURE 6
TYPICAL PASTURE BACKFILL

mining, can result in water passing from the surface mine into the underground mine and aggravating that problem. These conditions often make complete reclamation impossible, and in steep terrain the underground mine can supply the water necessary for the development for slippage planes in the spoils. Where underground mines are adjacent to the proposed surface mines, barrier pillars should be left. When a deep mine is breached, the opening should be sealed as soon as possible by clay compaction, concrete, or any other method deemed necessary.

Adjacent land uses and present use of the area before mining should be taken into consideration in planning the type of grading to be performed. In most cases, the area should be returned as nearly as possible to the topography existing before mining. The possible exceptions are the very steep contour mines and those situations where better land use and less environmental problems

would result by not returning it to the natural contour.

Silt structures and treatment facilities should be designed before mining ever starts.

The mining method itself should be evaluated to determine how the area could best be mined with the least environmental damage.

Mining the area is the next important step in environmental control. Before mining ever begins, the water control structures should be constructed. Well designed and constructed silt structures should be built following good design criteria for small impoundments including compacted dams, mechanical overflow structures, emergency spillways and adequate sediment storage. The pond should be designed to provide one hour of detention time at maximum flow and a minimum of short circuiting. Basically, it should remove all settleable solids and reduce the suspended solids to approximately 200 mg/l. Where

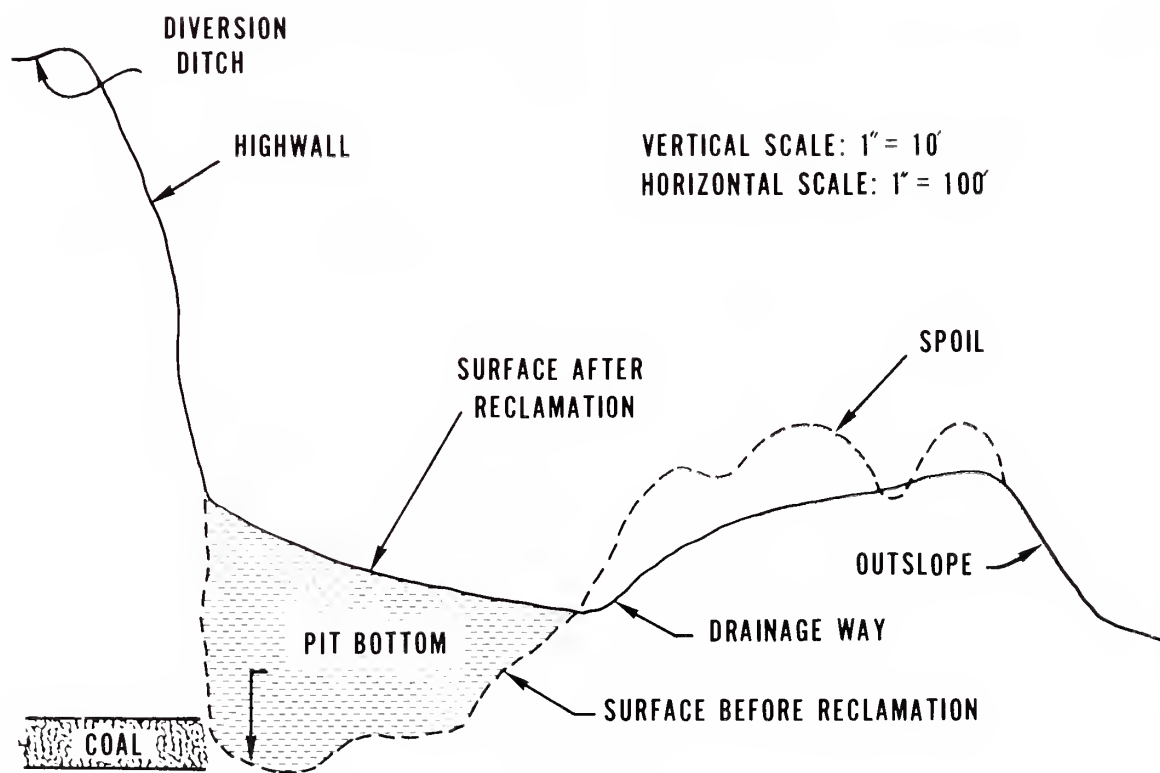


FIGURE 7
TYPICAL SWALLOW-TAIL BACKFILL

the overburden contains clay that will not settle from water, additional treatment with lime, alum, etc., will be required.

A treatment facility to assure that the water has a pH of 6 to 9, a net alkalinity, and an iron concentration of less than 7 mg/l should also be installed.

The haulage road, which is often a source of erosion, should be properly designed and installed. Proper grades and water control should be followed.

Care should be taken in cleaning and grubbing, cutting roads for drilling machinery and during blasting to protect the environment.

Diversion ditches with good controlled outlets should be constructed along the top of the highwall to keep water out of the workings. Drainage ways should be protected or control structures built.

Water that does enter the pit should be properly handled. In most cases this means rapid removal and discharge to a siltation pond or treatment plant. Under some conditions, where a workable system can be developed, it might be better to catch the water on the bench and control the discharge to the treatment facilities. Drainage patterns should be established in the pit to facilitate water removal. Water discharge from the pit area should be through well designed outlets and should not overload the natural drainage way. Proper management of water on the bench can markedly reduce the siltation and acid mine drainage problem.

Removal and placement of the overburden are critical in environmental control. The non-toxic, non-acid, and fertile material should be stockpiled for later spreading or placed on top of the less desirable spoils already mined. The placement of the spoil should assure that long steep slopes are avoided, that it is not on material subject to slippage and that it does not produce high peaks difficult to regrade. In very steep terrain, such as in eastern Kentucky and southern West Virginia, the spoil should not be placed on the out-slope, but hauled to a fill area designed for that purpose or placed on the bench behind the operation.

Reclamation should follow closely behind the mining operation. The bare spoil and pit should be reclaimed as fast as possible because the freshly

moved material is easier to grade and handle than older compacted material. In addition, bare spoils and pits are more susceptible to acid formation and erosion.

Area mines should be graded back to the original contour. Where the final cut can be permanently flooded above any acid producing strata, it can be left to form a lake. It may also serve as a silt trap. Care should be taken to assure that it has a properly designed discharge facility.

Three types of backfills might be used on contour mines: contour, pasture, and swallow-tail.

For a contour backfill, the edge of the highwall is "knocked-off" and the spoil is graded back toward the highwall to approximate the original contour (Figure 5). This method is the closest approach to returning the area to its original topography and produces the most pleasing aesthetic effect. Long steep slopes can be formed that are subject to erosion. However, the erosion problem can be solved by the construction of a diversion ditch at the top of the slope, of terraces, or of a series of diversions or ridges across the slope. Each of these measures should have a controlled outlet. Rapid vegetation with grasses and legumes is critical for this type of backfill. Contour backfills are preferred wherever possible.

Pasture backfilling calls for the grading of the spoil to cover the pit and any acid producing strata, but not the entire highwall (Figure 6). The slope of the graded spoil should be away from the highwall and the slope of the "outslope" should be reduced to control the water running off the bench. Diversion ditches should be constructed along the top of the highwall to reduce the water entering the pit.

Where it is necessary to grade the spoil toward the highwall, a swallow-tail backfill should be used (Figure 7). In this case a drainage ditch parallel to the highwall is constructed. This ditch is of sufficient distance from the highwall to assure that any material falling off it will not obstruct the drainage way. It should also be away from the final cut. The ditch should carry the runoff to a properly designed discharge structure.

Revegetation should follow the grading as soon as planting conditions are favorable. Grasses and/or legumes should be planted on all areas.

Trees may be planted in combination with grasses, but not alone as they require excessive periods of time to be effective for erosion control. Soil samples should be taken to determine the limestone and fertilizer requirements. Where possible, the ground should be loosened and the fertilizer and limestone worked in. Then the grass seed planted. On steep slopes hydroseeders and airplanes can be used to seed the area. A mulch may also have to be used. The type of grasses, legumes, and trees to be planted will depend on the local conditions, and the long-term use of the land.

GLOSSARY

The following terms used by the surface mining industry are defined here for the convenience of the reader. Reference 11, contains a more complete definition of mining terms.

Bench —	A name applied to ledges that are shaped like steps or terraces cut into the side of hills in the removal of coal.
Highwall —	The unexcavated face of exposed overburden and coal or ore in an area mine or the face or bank on the uphill side of a contour strip mine excavation.
Outcrop —	That part of the mineral formation that appears at the surface of the ground. It does not necessarily imply visible presentation of the mineral on the surface of the earth, but includes those deposits that are near to the surface.
Outslope —	The outer (away from the highwall) edge or face of a bench.
Overburden —	Any material, consolidated or unconsolidated, that overlies a deposit of useful materials, ores, or coal.
Spoil —	The overburden or non-ore material removed in gaining access to the ore or mineral material in surface mining.

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Soils are seen as a dynamic nutrient reservoir formed by slow geochemical weathering over periods of tens of thousands to millions of years. Nutrient cation exchange capacities vary as a function of the original substrate in young soils, climate, soil hydrology, and vegetation. Land use practices such as forest cutting upset the nitrogen cycle within the soil which may permit bacterial oxidation of ammonia to nitrate with release of hydrogen ions. These H^+ ions displace biologically available stored soil nutrients and, in some cases, may render a soil unable to sustain any but primary successional species within a few decades after forest removal. Forest fire may kill the surface soil microorganisms by both heat and

increase in pH and thus protect soil from natural nutrient depletion following fire. In addition, organic soil colloids are translocated into the superficial layers of soil during fire and further protect that soil from surface water erosion and clay-mineral nutrient leaching.

Major questions remain as to the effects of forest cutting and other land use practices such as repeated tilling and monocultural agriculture upon the nitrogen cycle and soil microfauna. Until some of these questions are answered, the advocacy of some federally approved and widely used logging practices is seriously questionable, and the consequences of continuation of present federal policies are grave.

Soil Destruction Associated with Forest Management and Prospects for Recovery in Geologic Time

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I am a geologist and geologists generally deal with non-renewable resources. Forests are supposedly renewable resources but, in the sense of the lifespan of mankind, forest soils are only very slowly renewable and I believe that many of the forests which these soils sustain are essentially non-renewable. Much of the American landscape, upon which we rely for water, enjoyment, mental well-being, wood products and foods, I believe may be doomed to the same fate that befell the great forests of Dalmatia under the Greek and Roman axes, the Cedars of Lebanon, and the once productive areas of the English Midlands. I should like to address myself to a geologist's

view of the development and maintenance of the world's soil resource and its conditions of equilibrium and disequilibrium. As an example of the biological crisis that faces much of this country as a result of short-sighted land use policies and lack of objective information on soils, I should like to discuss particularly the handling of our nation's forest resource. Much of this discussion will be directed toward management of the forest resource of western United States, but the principles apply to most attempts at management of primary biologic productivity from soil-covered lands including conventional agriculture and tree-farming as practiced in the Southeast.

In June, 1960, Congress passed the Multiple-Use Sustained-Yield Act (M.U.S.Y.A.) which, among other things, said that the National Forests should be maintained for multiple uses in *perpetuity*. Public debate, often rather one-sided, rages on about the merits of truck-mechanized logging in general as practiced in much of the U.S. including the Southeast and clearcut logging in particular. Most citizens are esthetically affronted by logged over land and intuitively feel that somehow the M.U.S.Y.A. is being interpreted to mean terminal logging. Such citizens frequently turn to the scientific community and a few renegade foresters to find valid proof that something is wrong with the forest practices that leave so much waste and ruin. Most technical criticism today is based upon erosion accompanying logging — there being some who believe that erosion is intolerably rapid while others claim some erosion is permissible and that the forests will not suffer as a consequence. Those pointing out evidences of rapid erosion sometimes argue that, while gullying and soil loss in the forests may not damage future forest growth potential; the effects of the transplanted silt, sand, and clay upon adjacent streams bothers them. The facts are that in almost all measured cases, soils in logged areas are being lost faster than they are being formed and the sustained yield concept is being patently violated. I shall return to this point with specific details later.

Another argument sometimes offered by those offended by current forest removal practices — euphemistically called “management,” is that actions in the once-forested areas upset the hydrologic regime of areas down valley from the cut-over watersheds. Although those complaining may have a valid argument, the law is such that it offers little or no protection from hydrologic variables — generally termed “acts of god” by the English upon whom our legal precedents in this area are based. In many geographic areas, United States Forest Service and commercial logging company personnel can correctly argue that forest removal actually increases total water runoff from a watershed. We all know that we need more water so just because your fields are flooded in the spring and the irrigation ditch goes dry in

the fall after forest excision, you shouldn't complain; someone downstream will be using that extra water, and we have made some more flood-control excuses for the Corps of Engineers. Also, it is agreed warm water is biologically more productive than that fishy cold water you had before. A Montana industrial planning director has gone so far as to suggest that westerners merely need to learn to relish catfish instead of native trout and they would then stop complaining about declining water quality.

In this paper, I wish to go into the data available on soil erosion and hydraulic variation associated with deforestation. I also want to summarize some recent work on soil and forest watershed chemistry that indicates that chemical reactions in the soil following logging in many areas cause the soils to be stripped of their nutrients so rapidly that soil sterility is virtually assured in a matter of two to, at maximum, six theoretical recyclings of forest growth — thus also fully negating the law as stated in the M.U.S.Y.A.

Let us first review some of the basic statistics regarding forests and forest production in the U.S. (derived largely from Statistical Abstracts of the United States, 1970).

In 1969, there were 600,000 lumber and wood products related jobs in the U.S. — 78,000 in the forests, 232,000 in sawmills, and the remainder in wood products manufacturing. The industry is losing people, offering 27,000 fewer jobs in '69 than in '60.

There are 0.76 million km² of National Forests, only 0.46 million of which actually possess merchantable trees — but this land produced a value of cut of 328 million dollars in 1969. Total gross receipts were actually only \$319 million — so someone did not pay up. The federal government allotted to the U.S.F.S., for fiscal year 1970's operation, only 31 million dollars — so you can see that they are quite dependent upon forest sales to exist as an organization — receiving only 12 million in income from grazing and special land use fees compared with 307 million for timber sales, of which most goes into the federal general fund. For comparison, Department of Interior had authorization for expenditure of \$967 million for the same year. Clearly, the U.S.F.S. funding

is grossly inadequate in terms of the area of land for which they are responsible. Additional burdens are placed upon the agency by the fact that appropriated funds are earmarked for items such as roads and trails, fighting forest fires, preventing forest fires, timber sales, etc., and little opportunity is allowed for ecologically sound agency operation.

Of the total of 3.06 million km² of commercial forest lands in the United States, the mountain states and west coast including Alaska hold 1.45 million km² while the south Atlantic and Gulf Coast states, including Texas, hold 0.81 million km². The 29 percent of the U.S. acreage in the south produces 31 percent of the nation's annual board-foot production while the 47 percent of the nation's acreage in the west produces 60 percent of its annual cut. This is so despite the fact that southern forests are more productive in terms of board feet of timber grown per acre. The anomaly is simply due to the fact that old-growth forests are still being cut in the west but not in the south.

In 1969, there were 38 billion board feet of timber produced in the U.S. total while we "consumed" some 43 billion. Consumption has been essentially steady since 1950. We export 1 billion board feet, mostly to Asia. Last year when the President was calling for a crash program to supply the nation's timber and cut over the remaining forests, the Port Orford, Oregon, lumber dealers had such a glut of sawn timber with no buyers that they took sawed and billeted timber and chipped it to ship to Japan where the inscrutable Japanese use our wastes to make particle-board for their own consumption and can profitably ship the excess back to the U.S. for sale in the northwest.

Imports, largely from Canada, account for the 6 billion board feet deficit. Standing sawtimber in the U.S., including Alaska, totals 2 trillion board feet. We would, therefore, have 50 years of consumption at our present rate remaining if no new timber grew. What are the chances that it will grow?

Before we begin to discuss forests and their soils, we must define a soil in some workable fashion. I see a soil as a dynamic biogeochemical system of nutrient and water exchange. As a soil

evolves, through physical and chemical weathering of rock and other parent materials at a given site, its ability to store and exchange upon biologic demand the essential nutrients for plant and animal growth increases with geologic time up to a maximum capacity, which it holds for several hundred thousand years, after which it slowly loses some of its nutrient exchange capacity. The nutrients exchanged are generally K, Na, Ca, Mg, & P with lesser amounts of the 14 so called micronutrients, like Fe, Mn, and Boron. The actual structures allowing this storage and exchange are clay minerals and organic soil colloids. Organic humus breaks down with time to a negatively charged complex which absorbs nutrient cations and keeps them from being readily leached away from the system by water as soon as they are released by chemical weathering of fresh mineral matter.

Clay minerals are complex alumino-silicate assemblages resulting from partial breakdown of some common rock-forming minerals like feldspars and micas. They are generally not present in any great amounts in unweathered bedrock or glacial deposits and should not be confused with "clay" in the sense that clay minerals have a specific chemical identity and physical structure, uniquely formed at or very near the earth's surface, whereas "clay" sometimes refers to a texture of clayey or silty particles which may or may not be composed of clay mineral particles.

The clay minerals are composed of sheet-like assemblages of Al, SiO₄ and OH⁻ molecules with spaces within the lattices and between the sheets to temporarily store cations like Ca, Mg, Al, K, etc., which can be released upon biologic demand or by leaching with acids whenever the small hydrogen ions squeeze into the lattice and bump the larger metallic cations out into solution. Plant root hairs release hydrogen ions to specifically accomplish their nutrient-gathering goal.

In summary then, soils are unique physico-chemical compounds which possess the ability to store and exchange nutrients. As bare mineral matter begins to accumulate a decomposing mat of humus and a few percent clay minerals, its potential nutrient storage budget increases and the kinds of plants it can support become more

varied and may constitute a progressively larger biomass. So-called primary plan succession is generally nothing more than a reflection of soil development.

Chemical weathering of organic humus and minerals to form cation exchange media goes on at a rate which is a function of temperature and available moisture. In areas with summer drought and cold winter precipitation (like much of the mountain west), soils can form only very slowly. In western Montana, for instance, it has taken about 16,000 years to form a 30-60 cm. deep mantle of partly weathered mineral matter and small accumulated organic mat. Most of this soil is merely a thin oxidized zone on the surface of the earth. These mountain soils have at most about 9.8 kg. of cation exchange media per square meter of land area.

Organic matter is found in the top few centimeters, while the clays, once formed, are translocated to a clay accumulation zone about 15 cm. beneath the surface. Below that depth, little actual storage of nutrients is accommodated and plant roots generally find physical support and water as well as rather minute amounts of nutrients derived directly from the bedrock or oxidized soil by biologic release of hydrogen ions or from downward percolating water that gained its nutrient load from the overlying clays plus organic acids.

When you remove the soil, you remove the ability of young plants to become established if those plants are dependent upon a full and readily available nutrient supply after germination. If one compares soil to the earth's full breast, then the top 15 cm. is the teat. Different plant species have different requirements. The so-called pioneering species like lichens can directly release nutrient cations from fresh minerals by virtue of possessing a complex chemical arsenal of acids of various unique types and an ability to withstand great physiologic drought. Some conifers and many shrubs can reproduce on a bare soil with little or no humus so long as some base-cation-exchange clay minerals are present near the surface. Other conifers and hardwood forest species require deep clay accumulations for metallic cation storage plus water storage and much available humus for harboring water, microflora

and fauna and essential nutrients like nitrogen.

One cannot readily "build" a soil. Laboratory clay mineral weathering is very time-consuming and natural distribution of clays is such that, although ubiquitous, there are not large minable deposits of clays of the types that hold most nutrients, like montmorillonite and vermiculite. Mere spreading of fertilizer on mineral soil or even incorporating it by tilling is fruitless and a criminal waste of energy. Without storage sites, the fertilizers merely dissociate and volatilize or leach away in 1-2 years, while many thousands of years are necessary for even the smallest accumulation of storage media. Leached fertilizers pollute streams and cause eutrophication by encouraging algal growth in those fertilized waters.

Erosion

Common erosion rates in tilled agricultural regions such as midcontinental U.S., average about 2-3 m./1000 years (compared with a pre-human erosion rate based upon geologic evidences of 5-10 cm. in the same areas) (Task Committee on Preparation of Sedimentation Manual, Committee on Sedimentation, Hydraulics Division, 1970; Walker, 1966; Ursic, 1965). Even in the warm, humid, long-stable southeastern U.S., soils seldom develop to much more than 3 m in depth and the young soils of glacial regions from Ohio northward possess generally less than 0.6 m of total exchangeable substrate materials. Clearly most U.S. agricultural regions will not sustain tilling for more than 300 years and many such hill regions in the southeast and the arid regions of Oklahoma and Texas are nearly depleted of their soils today and require annual expenditures of fertilizer and much energy just to make the most primitive plants grow.

For the U.S. as a whole, without the intervention of mankind, soil erosion goes on at a rate of about 3 cm per 1000 years (Judson & Ritter, 1964; Corbel, 1964). Thus, on the average, soils would have to form at a rate equal to or greater than 3 cm/1000 years or 3 mm/century to allow equilibrium. For the mid-temperate latitudes, this seems to be about the right order of magnitude. But averages do not tell the forest story. For montane western Montana about 0.7 m of soil,

not all composed of materials with exchange capacity, has formed in 16,000 years for a rate of or 3.8 cm/1000 years absolute maximum rate of formation. True average rates may be one-half this figure. Local erosion, on specified watersheds, is as much as 15 cm/100 years — or 162 kg/century removed from each square meter per century. If formed at a rate of 3.8 cm/1000 years and 0.7 m deep, we would have 400 years of soil left to be stripped. Since the 15 cm-rate, as measured from rates of siltation in streams and behind debris dams in small watersheds in logged areas, appears to have been in force for the last 50 or more years, we may have as little as only 350 years of forest soils left in some locales. Or perhaps enough time for three more cuts before sustained yield becomes a joke.

Erosion can be estimated from measurements of sediment carried in streams draining the areas (Ursic, 1965). Turbidity is not a measure of rate of erosion. There are three basic reasons for this:

- 1) Significant erosion can occur without measurable turbidity. By recent measure in a U.S.F.S. experimental forest, 100 kg/ha/yr suspended particulate matter can be carried off a small 160,000 m² (39 acre) deforested watershed without any measurable turbidity (Likens, et al, 1970). That is a lowering of 1.4 cm/1000 years or about one-half the rate of soil formation.

- 2) Erosion selectively removes the cation exchange media — the clays because they are light, fine and easily mobilized by water since they repel one another having like negative charges; and the organic matter since it lying upon the ground surface. Natural clear runoff contains about equal parts of mineral matter and organic matter.

- 3) Erosion can progress in deforested watersheds at great rates without the material actually reaching a stream for measurement. Current "good" management practice is to leave a vegetation buffer along streams to protect fish from water heating and stream siltation which deleteriously affect salmonid species. The Federal Water Pollution Control Administration also recommends debris dams and the leaving of slash on the deforested hillsides to reduce sediment reaching water courses. This is all well and good but it does little to protect the soil — only the fish — and it even protects the fish only from silt without regard for the chemical quality or toxicity of the water. I will show shortly how this practice of leaving forested buffer strips along streams, while preserving spawning grounds a little longer, is assuring high fingerling mortality from chemical water

pollution in that supposedly clear water draining "properly logged" watersheds is toxic to young fish near the logged regions.

When logging occurs in steep watersheds, erosion rates go up tremendously. In the Coast Ranges of Northern California, I and others have estimated regional rates of erosion based upon suspended sediment loads in streams to learn that, for instance, there is an average rate of lowering of 15 cm/100 years for the entire 7800 km² area of Eel River Basin (Wahrhaftig and Curry, 1967; Wallis, 1967). In this area of the redwood forests, soil is being lost 100 times faster than being formed for a predicted total soil loss in 400 years — much less time than it takes to grow a single second crop of the indigenous *Sequoia* on hillslopes.

Recent work by the U.S. Geological Survey and University of California personnel have shown our original estimates of rate of erosion to be far from correct. Our error was in assuming that the measured suspended sediment load of the river represented the total eroded materials. Later work measuring sediment load transported down the bed of the Eel River and tributaries showed the true erosion rate to be greater than our estimates. Since soil is largely carried as suspended particles, and since gullying supplying the bedload progressively exposes more topsoil to erosion as the gullies work headward, a value somewhat less than 400 years to total soil loss is probably most nearly correct.

Theoretically, areas with thick mature soils, much clay and organic matter, and a long geologic history of weathering and rapid soil formation should be the ideal places to log. In the U.S. such places are restricted to the Southeastern states (Georgia, N. Florida, Alabama, Louisiana, Texas, and the Carolinas) and coastal parts of the Pacific Northwest. Here soils are deep and should tolerate some erosion.

In the southeast, the deep red lateritic soils of the coastal plain are among the deepest and best developed in the United States. This is so because stable land surfaces have been exposed to warmth and summer rains for 2 to 10 million or more years to thoroughly weather and leach the top 6 or more meters of surface materials. Due

to the high soil moisture and high ambient temperatures, as well as copious acid litter production and flat poorly drained topography, southeastern U.S. soil production would be higher than at any other U.S. site except parts of Hawaii. In the southeast rates of initial soil formation may be on the order of 6 cm/1000 years based upon soil development on elevated Pleistocene marine shorelines, but this rate of two or more times the national average drops to as little as 0.3 cm/1000 years after forming 3-6 m soil-depths in 1-2 million years. Thus, although initial rates of formation are high, limitations on effective depths of oxidation and hydrolysis ultimately limit the depth of soil development and further time merely permits the slow solution of the less soluble components of the soil and its nutrient loads, resulting in eventual breakdown of the clay mineral structures themselves. Thus, in the tropics and older soils of the southeast, organic soil colloids and the actual standing biomass comprise the major reservoir of nutrients. Areas subject to repeated fire or export of nutrient-containing biomass cannot long support a diverse flora and stands of low species diversity result, composed of species like slash pine and palmetto adapted to nutrient poor sites.

In the west, I have been recently looking at Oregon Coast Range soils in the Alsea and Unqua watersheds, especially those on old, flat, wave-cut marine terraces now elevated above the sea because erosion on flat areas would be expected to be low and rates of soil formation and past geologic erosion can be deduced from the ages of the terrace surfaces.

A cut through a 2-4 million year-old soil in Weyerhaeuser forest lands at about 300 m elevation between Eugene and Pt. Orford, shows a deep lateritic weathering profile reflecting virtual stability of this land surface for millions of years. Fossil evidence leads us to believe that this area has supported the present forest species for over 4 million years.

Nearby exposures of a younger forest podsol on top of the latosol suggest at least some periods of different soil-forming conditions during the cool wet periods of the glacial times when precipitation here may have reached 380 cm/annum

(150"/annum) in comparison to today's 254 cm (100"). Absence of these younger soils or a thick humus layer on ridge tops suggest natural cumulative erosion of about 0.9 m (minimum) of soil in the last 500,000 to 1 million years (0.1 cm/1000 years). Today, following logging, these soils are gullying at an alarming rate. Ridgetop gullies do not normally occur in this country, even following severe fire (and I shall explain why this may be so later). Headward valley erosion is very slow and apparently confined to certain geologic episodes of changing sea level and stream regimes, coupled with sporadic landsliding to initiate the gullies. Healed gullies formed naturally before deforestation are not observed. Here in Oregon's Coast Ranges, erosion rates are likewise 100 to 1000 times the rate of soil formation and make a mockery of sustained yield concepts.

Thus by erosion alone, we are directly and surely turning parts of our western states into Dalmatias. It took 500 years to strip the soils from the 250-cm-rainfall-areas of the Dalmatian coast with more like 1000 years to denude the soils from Israel, Turkey, Greece, Italy, and Lebanon. Those poor Romans and their predecessors were without logging trucks and bulldozers so hadn't a chance to achieve our rates.

Floods and flooding accompany our deforestation, just as in the European case, but at least we haven't Florentine art treasures to lose. Shrubs, like nitrogen-fixing alders, the devils club of British Columbia and the Pacific Northwest; the chaparral of California and the gorse of Oregon (introduced from deforested areas of Ireland and Scotland) are replacing our forests and may remain there for the thousands of years necessary to replace the cation exchange media. In the northern Rocky Mountains, it appears that about 5,000 years was necessary for the succession leading to our present forest ecosystems and this occurred at a significantly wetter and possibly slightly warmer more favorable soil forming time accompanying and immediately following our last deglaciation (see for instance Bryson, 1968). Today, it would probably take longer. One thousand years after final deforestation, the Mediterranean hillslopes have been negligible soil reformed. Progressive climatic change often renders forest

ecosystems unstable after deforestation since inadequate soil moisture may be available for natural reproduction. Thus the coastal watersheds of California were deforested of redwoods *naturally* (probably by repeated fires) about 10,000 years ago and could not reproduce rapidly enough to save the soil from subsequent erosion so lost out to pioneering chaparral. Relict stands, like those on the San Francisco peninsula, once cut are doomed since they are creating their own microenvironment and retaining their own soil. The same holds true of interior mountain west and parts of eastern U.S. Lodgepole pine scavenges up sites deforested of Douglas fir and Ponderosa, tolerates more soil erosion and less cation exchange capacity, and in some cases more summer drought. Weakened Ponderosa pine populations in Idaho and Montana, now made up dominantly of young individuals, are subject to more frequent and more highly virulent diseases than are mixed age stands. A viral disease is now sweeping the young Ponderosa of western Montana.

Thus erosional evidence gives us a finite life for our forests in all but the flat deep soil areas of the southeast where tree farms can be carried on like any other farming with full utilization of the materials and slow nutrient depletion offsettable by expensive and extensive fertilization.

Congress seems little concerned, and understandably so, about geologic rates of erosion — after all — M.U.S.Y.A. surely isn't expected to hold up for 400-1000 years, and anyway those responsible for its passage and its carrying out won't live to see the consequences. Do the Roman navies really care that Dalmatia is now scrub as a result of the construction of their warships?

Nutrient Depletion

Forest Service personnel and the general public have long noted that some logged areas do not recover, but instead become open grasslands or bald areas despite attempts to replant such areas (fig. 1). Frequently competition from understory species is blamed for the seedling failures and, upon occasion, published reports may speak of "climatic change" or periods of unusual summer aridity as being responsible. Other examples



Figure 1. — Forest plantation, Robbins Gulch near Darby, Montana. Area was planted with Douglas fir seedlings in 1966. This photo was taken in May, 1970. Note extensive growth of nitrogen-demanding thistles, indicative of upset of soil biogeochemical nitrogen cycle.

of regrowth failure occasionally quoted are insect or viral infestations selecting seedlings, ground-squirrel or gopher disturbance of the seedlings or seed, and small mammal or bird use of the artificially broadcast seed as food.

In the mountain west, probably the most common cause of the formation of such artificially deforested areas is slow progressive climatic change wherein increased summer aridity limits reproduction of tree species outside a forest canopy. However, this alone cannot explain why some areas, particularly those in more mesic clear-cut sites, seem to recover with such decreased vigor of growth of replanted species (Bolle, et al. 1970). Climatic change can logically be called upon to explain the uphill migration of the lower forest-grassland ecotone found in much of the arid-summer areas of the west but cannot well explain the lack of recovery or weak recovery of the higher elevation areas. Especially confusing is the role of fire. One can logically ask why a cut-



Figure 2. — Terraced clear-cut, Bitterroot Valley, western Montana. Both terracing and clear-cutting are practiced throughout much of western United States as a means of exposing shade-free bare mineral soil in order to promote monocultural forestry for second generation growth. At this spot, 20,000 years of accumulated soil and its stored nutrients were removed in a single season. Regrowth by pioneering species such as the Douglas Fir is slow and natural reseeding almost impossible.

over forest will not recover with vigor even when artificially replanted, yet a similar area may reseed readily with high survival after a fire. Since most western logging operations do not export much of the biomass from the forests but leave it as slash which may be burnt to recycle the nutrients, the answer to this enigmatic observation cannot be simply a question of recycling of above-ground nutrients.

Two kinds of recent research have suggested possible explanations for the problem of lack of forest recovery on logged watersheds. The work in question here is that done on the Hubbard Brook experimental watershed in New Hampshire and that done on water-repellency of forest soils following fire.

The Hubbard Brook study in particular has spurred similar research in the Pacific Northwest and Northern Rockies where clear-cutting practices (fig. 2) constitute the most frequent man-

agement decision of choice by the U.S. Forest Service and yet do not seem to be recovering according to the management manuals. The Hubbard Brook study has demonstrated that certain conditions lead to marked loss of productivity of forest soils through nutrient depletion following a single cutting. If similar biogeochemical upset is going on in the west where the bulk of the nation's forest reserves remain, the consequences could be grave indeed. Preliminary evidence suggests that the western forest soils are being depleted of their exchangeable nutrients although the actual processes of nutrient loss have not yet been fully studied. A chief difficulty is that the Forest Service does not maintain adequate research personnel or facilities in the west and is at present completely unable administratively to approach the challenge of responsible management based upon scientifically prudent decisions.

In the Hubbard Brook study, an interdisciplinary team of foresters, biologists, and geologists from Yale, Dartmouth, the U.S. Forest Service, and the U.S. Geological Survey set up a rather drastic study in which, in the winter of 1965, a small 160,000 m² (39 acre) watershed near Hanover, New Hampshire in the U.S. Forest Services' Hubbard Brook experimental forest was clear cut, by hand, without any vehicles and with virtually no disturbance to trigger erosion (Likens, et al, 1970; Bormann, 1968; 1969). Immediately adjacent to this watershed were two similar-sized unlogged watersheds used as controls in the experiment. All of the trees, largely hardwoods and shrubs were cut to within 1.5 m of the ground and all were left in place—not exported from the ecosystem. The following spring, in 1966, a herbicide (Bromacil) of known chemical composition was carefully applied to suppress virtually all growth. The purpose of this was to see what would happen when the nutrient and hydrologic cycle was interrupted. The New England forest assemblage differs from those of the western states in that the species are largely deciduous and the soil has thus several cms of humus. The New Hampshire glaciated terrain of metamorphic rocks supported a 10-15,000 year old forest podsol soil of acid pH, somewhat different from those of the mountain states except the Cascades and

Oregon coast range, where one finds similar but better developed soils. Soil depths of Hubbard Brook are similar to those in the mountain west on similar aged materials but clays are kaolinitic rather than montmorillonite, and more litter is present to support a total greater ion exchange capacity, although less saturated with nutrients than found in western soils. Precipitation at Hubbard Brook is about 125 cm annum (49 in.) with $\frac{2}{3}$ of it occurring in the summer.

As was expected after clear-cutting, annual runoff increased 30-40% over the values for the same uncut area. Summer runoff, without vegetative transpiration and interception, increased over 400%. And, of course, the runoff was warmer and the snow melted faster.

For the two springs following the cutting, there was no increase in turbidity and the drainage water ran clear and apparently clean. Analyses showed that, indeed, particulate matter had increased about 4-fold in the runoff, possibly due to increased raindrop splash erosion without protective forest canopy, but the water looked potable and drainages did not silt up.

Then Gene Likens, the aquatic ecologist of the team, began to look at the runoff water chemistry. Total chemical input from precipitation, which contain significant numbers of ions in the polluted northeastern skies, as well as the compounds introduced in the herbicides, was accurately known (Fisher, et al, 1968; Likens, et al, 1970).

Outputs of ions, as measured by stream water chemistry for two years following cutting, increased dramatically. Even though there was more runoff to dilute it, average stream water concentration from the deforested watershed increased by:

417% for Ca
410% for Mg
1558% for K
177% for Na

and $56\times$ for nitrate concentration (reaching levels of 82 ppm on occasional months—or $2\times$ the Public Health standards for potable water without nitrogen poisoning) (McKee and Wolf, 1963, p. 224).

Ion flushing was going on with total dissolved nutrients being withdrawn at the rate of 97 metric

tons/klm²/year by the 2nd year or 8 times greater than would be expected for an undisturbed watershed.

Ninety seven metric tons/Klm² sound like quite a bit; but indeed, if one assumes a generous set of values for cation exchange capacity in soils of the mountain west of 20 milliequivalent/100 gms and 95% base-saturation of all storage sites and a full 30 cm of clay and organic rich soil, we could generously estimate that beneath western forests there would be something like 1700 metric tons of nutrient cations per sq. klm in storage. This is about the right order of magnitude for well-studied coniferous forests in similar young soils in the U.S.S.R. and Bavaria, and deciduous forests in Belgium—although those areas all have faster rates of soil formation (Duvigneaud and Denaeyer-DeSmet, 1970, p. 199).

So if nutrient leaching were to occur in the west as in the northeast after clear-cutting, and if the western soils did not erode at all and lay on perfectly flat ground, we might predict nutrient sterility 17.5 years after clear-cutting. Even if there were ten times the exchange capacity estimated, as for instance might be the case in western Washington, sterility might occur after only 175 years—i.e., before erosion strips the soil. But we do not know if the same processes are operating in the west as were found in the Hubbard Brook study, we do not know how long such leaching may progress after deforestation, and we do not know how much the forest understory, which was suppressed by herbicides at Hubbard Brook, may take up the biogeochemical slack and protect the soils against nutrient loss.

Likens has reported (personal communication, 1970) that analyses of runoff from old logged areas in New Hampshire still reveal higher than expected outputs of nutrient ions 10-20 years after logging. This might be due to the chemical nature of rainfall in that eastern area (pH 4.0 or less as weak nitric or sulfuric acid), which results from air pollution upwind in the vicinity of the southern and eastern Great Lakes. The answers to these and other fundamental questions must be answered before wise land-use decisions can be made based upon other than speculative information. To date, little or no effort is going

into answering these questions from either federal, state, or private research agencies.

What apparently happens at Hubbard Brook is that as the spring sun warms the cut over area, the forest floor microflora convert organic nitrogen into ammonia. This ammonia is then rapidly oxidized at warm temperatures by bacteria (*Nitrosomonas* spp) to nitrite + H^+ ions. The nitrite is then further oxidized by other bacteria (*Nitrobacter* spp) to nitrate which runs out of the system in solution, while the hydrogen ions released in the first reaction displace the nutrient cations in the clays and organic colloids to flush the nutrients from the system with the spring runoff.

The soil bacteria multiply rapidly after clear-cutting severs the nutrient cycle. Then the released cations enrich the streams and lakes as they flow seaward to cause local eutrophication, just as would be expected if one dumped fertilizers or phosphate detergents into a stream or lake. Soil bacteria may theoretically continue to function until all the sources of organic nitrogen are consumed or until vegetative growth recouples the nitrogen cycle. In the east, the litter layer and organic colloids supply the chief sources of organic nitrogen, as well as much of the cation exchange capacity. Regrowth of understory species is usually rapid in areas of natural disturbance or logging and one would expect that the nitrogen cycle would be completed but a few years after disturbance. In the west, however, where litter layers are weak or altogether absent, the largest nitrogen reservoir is to be found among the organic colloids within the mineral soil (Jenny, 1967, p. 31). This, coupled with the lesser acidity of western rainfall wherein most rains are weak carbonic rather than nitric or sulfuric acids, should theoretically make the possibilities for micro-organism initiated soil nutrient leaching less severe in the west, but the counteracting problem of summer drought and much slower resultant recovery of an understory or shrub layer may allow interruption of the nitrogen cycle and nutrient leaching for as long as 20 to 100 years, thus requiring nitrogen-fixing species such as Alder for long successional intervals after disturbance. A few years of leaching in the northeastern hard-

wood forests would remove only on the order of 10 to 20 percent of the total exchangeable soil nutrient ions, but a 20 year leaching in the west could more than deplete the entire 15-25,000 year nutrient accumulation in the soil reservoir.

It is thus the interruption of this nitrogen cycle that flushes potentially available nutrients from the ecosystem. General studies of micro-nutrient cycling in forest ecosystems usually separate closed biologic nutrient cycles and open geochemical cycles and, prior to the recent Hubbard Brook study, the effects of biologic organisms on the geochemical cycle has not been fully appreciated. Nutrient losses from forest ecosystems with the occasional exception of calcium, have not been theoretically predicted and thus not looked for in previous studies (Leopold, 1970).

At Hubbard Brook, additional soil acidity resulted from the presence of $SO_4 =$ (sulfate) in the polluted precipitation. In the west, we do not have anything like this except around large metropolitan areas, power plants, and smelters and in many such areas nutrient flushing has already gone on to such an extent that trees no longer grow to merchantable saw timber size and all that can be done with them is to pulp them for paper to liberate airborne sulfate from the pulp mills.

The single most pressing question raised by the Hubbard Brook study is is it happening in the mountain west? How do we measure it without this sort of destructive test cutting?

Three things suggest strongly that it is:

- (1) Electrical conductivity of water draining clear cuts is 4-6 to even 10 times greater than before cutting — suggesting increasing dissolved ionic load.
- (2) Eutrophication can be observed in streams and ponds below deforested hillsides with scummy streams and algal blooms directly correlated with percentage of the watershed cut in the previous two years.
- (3) Trees do not grow as big as or as quickly as the forestry texts say they should or older foresters remember. Some clear cuts, without evident bare rock, just do not reproduce — and when replanted time and time again, the brush and alders seem to have a competitive advantage over trees.

Hard data is needed and is not being sought. President Nixon may soon again be calling for a

doubling of forest cut to meet national needs. This increase must largely be met in the west as the southeast has quite accurately demonstrated that it can yield no more on a sustainable basis — even with massive fertilization. Forest Service personnel will be forced to act without knowledge and will, in my opinion, be committing pedological and ecological mayhem.

Forest Fires

One may well ask, perfectly logically, why all this does not happen after forest fires and how forest soils survive in the first place if they are so sensitive? I do not have a firm answer but have been perplexed by this problem for the last year and have the following theory:

Forest fires release amounts of nitrogen and other nutrients by taking it out of the standing crop and dropping it on the soil as ash. Hans Jenny (1962) has estimated that a California Ponderosa pine forest of 120' trees contains 57 gm of nitrogen per m² above ground and 360 gm per m² below ground. Even the heaviest experimental burning did not reveal a measurable loss of nitrogen from the soil in Jenny's experiments. However, fires also temporarily kill off much of the soil microflora and fauna directly, and indirectly suppress recolonization of some through the effects of the fire ash on the soil pH. These soil organisms thus release their own nutrients to the system without forming and oxidizing the ammonia to release the hydrogen ions to flush the cations. Thus after a hot fire, a rich layer of nutrients lie on the surface in the form of alkaline ash and the soil nutrients remain fully stored and available for the next cycle of forest growth.

But why do soils not erode completely after repeated fires? We can see that southern California's fire-maintained chaparral ecosystems are virtually without soil clay mineral cation exchange media and are known to erode rapidly after each fire, so why does this also not happen in each of the Pacific northwest, mountain, and southeastern soils after burning?

I have observed that adjacent watersheds in southern Oregon's coast Ranges — one clear-cut

by cable methods — not roads; and another burned at the same time without cutting, show marked differences in soil retention. It remains to be proven, but I think the reason for this may lie in the fact that hydrophobic organic colloid substances are translocated along a temperature gradient down into the soil from the litter layer during a fire. The hotter the fire, the more evaporation of organic matter in the litter layer and the more precipitation of same in or on the mineral grains a few inches below the soil surface. This organic complex apparently causes the soil to repel surface water. USFS personnel have reproduced this effect in the laboratory and note that the organic-coated soil sheds water readily thus decreasing the capacity of the soil to absorb precipitation after a rain and increasing its overland flow yield to form severe flash floods in the river bottoms after fires but much less soil erosion than would be expected (DeBano, et al, 1969, 1970). Once established after a fire, grass and other vegetation seem to break down the organic cement and render the soil essentially the same as before the fire except that more organic matter capable of affording greater cation exchange capacity is found in the soil profile so the net result is an increase potential soil productivity and cation exchange capacity after a fire as compared with a marked decrease after forest extraction.

Conclusions

Present evidence suggests forest cutting, by any but the most conservative and careful methods, appears to defeat the soil-plant nutrient cycling and soil nutrient storage capacity, as well as increase erosion. Some western forests may have something less than 200 years of productive fertility remaining before permanent (in the sense of man's remaining timescale on earth) eradication of productivity for saw timber production. Means of chemically monitoring the effects of logging practices are not so complex that any reasonably competent citizen's organization should not be able to measure electrical conductivity and clay mineral and organic matter content of soils and their drainage water. I believe such semi-

quantitative citizens-data should be adequate to force full-scale soil stability investigation or reconsideration of land use, where appropriate, by agencies independent of the U.S. Forest Service, U.S. Department of Agriculture, and Soil Conservation Service, all of whom have had bias or technical limitation (Leopold, op. cit.). The matter is, in my opinion, so serious and potentially so completely damaging to our agricultural and forest lands that a full scale crash 4-year nationwide fact-finding effort should be undertaken now, administered by non-governmental and non-industry related agencies and personnel but working in cooperation with federal land-management agencies. A 4-5 year national forest cutting moratorium might further afford economic incentives to establish full scale paper recycling and waste-wood use to permit adoption of the better portions of European silvicultural practices upon re-opening our own public and private forests to carefully controlled selective cutting.

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The estuarine ecosystem has three major components: (1) the biophysical environment—the natural components; (2) the socioeconomic environment—the human use components; and (3) the institutional environment—the man-made controlling components.

The biophysical environment in its unaltered state is a balanced self-regulating system. The socioeconomic environment is a system weighted in favor of man and his activities. This imbalance has created the pressures and activities that have caused damage and destruction in the estuarine area. This damage and destruction in the estuarine area along the U. S. East Coast has greatly increased during the past 20 years. The major causes are: (1) dredging and filling in coastal waters and dune destruction on shorelines for housing, industry, and transportation; (2) increased entry of domestic and industrial effluents into coastal waters; (3) mining; (4) solid waste

disposal; (5) insect control activities; (6) water development programs; and (7) upstream activities. A reversal of this trend is beginning as a result of research, development, and installation of man-made controls. More strength and improvement within the institutional environment, coupled with the development of additional administrative and legal restraints, will provide for a better balance between conservation and development than now exists.

Each of the three components of the estuarine ecosystem will be forced to adjust to achieve balance of the complete system. The limits of the components' abilities to adjust are not known and the degree to which damaged systems can recover cannot be predicted. If the estuarine ecosystem is to remain viable, the limits and ability to recover must be determined to insure that all controls necessary to prevent these limits from being exceeded are installed.

Damaged Estuarine Ecosystems, Their Restoration and Recovery

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The estuarine ecosystem contains three major components: (1) biophysical environment—its natural components; (2) socioeconomic environment—use components; (3) the institutional environment—the man-made controlling components.

From the standpoint of its biophysical components, the estuarine ecosystem was first discovered in the early 1950's through the efforts of Professor E. P. Odum of the University of Georgia. The role of the salt marsh in the estuarine ecosystem and its importance to coastal fisheries was brought to light. Dr. Odum and his colleagues have defined the gross attributes of the estuarine

area. Research by others has provided detailed confirmation of the generalizations developed by the Georgia group. During the intervening 20 years, refinement of the data has been accomplished by intensified estuarine research throughout the United States and in many foreign countries.

The following statement was presented in the hearings on the estuarine area before the subcommittee on Fisheries and Wildlife Conservation to the House Committee on Merchant Marine and Fisheries, 90th Congress First Session, and summarized the biological "value" of estuaries. "The estuarine complex is generally very fertile and

production of plant and animal life is more productive in general, than either land or sea. This is due in large measure to the dynamics of the tidal cycles, which mix freshwater with its burden of materials from the land — all too often humus and the best topsoil — with the mineral rich sea water and the organic products of underwater decay that are not allowed to stay settled on the bottom.

Thus a sort of constantly disturbed rich broth is provided in a sheltered environment for small and microscopic plant and animal plankton to form the abundant food for successively higher links in the food chains that make up a web of life. The result is phenomenal. Perhaps two-third of all coastal sport fish are estuarine dependent during part of their lives.

Some single estuaries are the spawning grounds, nurseries, or growing-up places for two dozen or more species of commercially important shellfish, crustaceans, and fin fishes."

This, in general terms, describes the biophysical environment which, in its unaltered state, exists as a balanced, self-regulating system. When the activities of man are superimposed upon this natural environment, a second component comes into play. This is the socioeconomic environment, or the human use component. The estuarine area is plagued by pollution problems as are all other areas of the country. But there are additional human use components in the coastal area which have far reaching, detrimental effects. These are the gross physical alterations produced by man which result in a reduction in area of estuarine marshes and open water.

In 1967, the U.S. Fish and Wildlife Service tabulated the 20-year loss of estuarine fish and wildlife habitat along the ocean coasts and Great Lakes' shores. These estimates showed that, during this period, more than seven percent of the total area of this important habitat had been destroyed by dredging and filling. The percentage of habitat destroyed ranged from a high of 67 percent in California to 15 percent in New York, 13.1 percent in New Jersey, 10.3 percent in Connecticut, and 10 percent in New Hampshire.

The damage and destruction that has occurred in the estuarine area along the U.S. East Coast, is

in seven major areas. These are: (1) dredging and filling in coastal waters and dune destruction on shorelines for housing, industry, and transportation, (2) increased entry of domestic and industrial effluents in the coastal waters, (3) mining, (4) solid waste disposal, (5) insect control activities, (6) water development programs and (7) upstream activities. Methods of controlling these damages to the estuarine area are being developed through the institutional environment.

The 1899 Rivers and Harbors Act, which governs the activities of the U.S. Army Corps of Engineers, has provided the mechanism for controlling dredging and filling in coastal waters. The 1899 Act also provided a means for controlling the entry of pollutants into the waterways of coastal waters although this was not widely known until recently. The same Act can apply to mining. Solid waste disposal and insect control activities are generally carried out for the public good, but may or may not have controlling devices in the statutory authority which established them. Water development legislation also has built-in control mechanisms hopefully insuring that these developments be conducted in a manner not detrimental to the estuarine area.

Upstream activities are more nebulous and probably the most difficult force with which to come to grips. Although these may be subtle changes, they may well have the greatest long range effect of all the seven major areas listed. Upstream activities consist of entry of agricultural fertilizers into waterways, entry of pesticides sprayed on agricultural crops, runoff from intensified agricultural activities (feed lots, etc.), and increased silt loads from poorly conducted highway building operations and poorly conducted housing developments. It has been reported that silt is the major pollutant present in the surface waters of the United States.

An awareness of the magnitude of losses in the estuarine area has prompted federal and state governments to initiate actions to stem the tide of wholesale destruction. Federal interest has been expressed in broad terms through such congressional legislation as the Marine Resources and Engineering Development Act of 1966, and Sea Grant College and Program Act of 1966. Fed-

eral acts have established a cabinet level National Council on Marine Resources and Engineering Development in the executive office of the President, and a separate advisory study group — the Commission on Marine Science, Engineering, and Resources.

Some of the states took action even earlier than this. For example, in 1963 the Massachusetts Legislature assigned to the Director of Marine Fisheries certain responsibilities for regulating removal, filling, and dredging of certain areas bordering the coastal waters of the commonwealth. It also provided that if the area in which the proposed work was to be done contained shellfish, the Director of Marine Fisheries could impose such conditions on the proposed work as he determined necessary to protect such shellfish or marine fisheries. This Act was tested in the courts of Massachusetts in 1964 (*Commissioner of Natural Resources et al vs. S. Volpe and Company, Inc.*) In 1965, California, through an act of its legislature, created the San Francisco Bay Conservation and Development Commission. This Commission was directed to study the bay. It has prepared a comprehensive conservation and development plan for the bay and its shore line. To protect the bay during the planning period, a permit to conduct dredging and/or filling had to be obtained from the Commission. Other states that have methods whereby dredging and/or filling can be controlled are Connecticut, Florida, Maine, North Carolina, Louisiana, and Texas. Marsh land acquisition programs are underway in New Jersey, New York and North Carolina. These programs are attempting to reduce the problem of habitat loss by bringing into public ownership areas deemed to be needed for the continuation of a healthy estuarine fishery.

Another method for protecting estuaries, instituted at the State level, is a rule-making approach such as has been adopted by Massachusetts. Through statutory authorization, the Commissioner of Natural Resources, with the approval of the Board of Natural Resources, may adopt regulations concerning alteration or pollution of coastal wetlands. If these regulations are found in court to constitute taking of property without just compensation, the Department may proceed to con-

demn the land through its powers of eminent domain. This legislation was enacted after extensive studies and reports. The Department of Natural Resources regards the rule-making authority as the most promising approach to control of estuarine destruction. It permits the Department to work on a regional basis to preserve wetlands without waiting for actual development commitment. Under this law, the Department has established protection covering 8,000 acres on the north shore of Massachusetts administered by the Department of Natural Resources. This rule-making authority has not been tested in the courts of Massachusetts at this time.

One can see from this brief discussion that the components of an estuarine ecosystem, the natural components, are regulated first by the laws of nature. When the socioeconomic environment, or human use component, is superimposed upon the natural component it can only be controlled through the institutional environment, the third component, in the estuarine ecosystem. This is the direction in which we need to be moving at the federal, state, and local levels.

The question that obviously arises is that since controls exist, why do we have problems of such magnitude? With control there must be enforcement and it must go hand in hand and receive equal emphasis. The full contents of the 1899 Rivers and Harbors Act have not been enforced. All of the control components of water development acts and legislation have not been enforced. Pollution control laws which should govern upstream activities have not been enforced.

There is, however, an indication of a reversal in this trend. As a result of research and development activities by various federal and state programs and study commissions, the value of this area has been documented. The detrimental effects resulting from human use have been isolated. An increased activity and movement toward greater exertion of man-made controlling components is in full swing at the federal, state and local levels of government.

In order to speak more directly about restoration and recovery of damaged ecosystems, the topic of this symposium, we would like to make some specific comments about what has been done,

and what is being proposed, in our own State of North Carolina.

In 1969, the North Carolina General Assembly enacted G.S. 113-229 which provides that, "before any excavation or filling project is begun in any estuarine water, tidelands, marsh lands, or state-owned lakes, the party or parties desiring to do such shall first obtain a permit from the North Carolina Department of Conservation and Development." This law was enacted to counter the problem of indiscriminate filling and excavation of marsh lands along the coast. It requires any person, firm or corporation prior to beginning any work in the coastal areas to make application to the State for a permit to authorize the project. This does not necessarily prohibit all work in marsh lands and estuarine waters but does give the State an opportunity to examine the proposed project, and to grant, deny, or modify a permit before the project begins.

This is far more power than the State had prior to 1969 when anyone could dredge almost at will in the waters and marsh lands of the State. Of course, a U.S. Army Corps of Engineers' permit was required, and the Corps did give the State the opportunity to comment on a federal project. However, the Corps' jurisdiction is restricted to navigable waters only. Thus, dredge or fill projects in non-navigable waters and in marshes were subject to neither federal nor state control. The 1969 law rectified this by giving the State authority to review dredge and/or fill permits. The authority to administer this Act was assigned by the Director of the Department of Conservation and Development to the Division of Commercial and Sports Fisheries.

In practice, an application is circularized to all interested State agencies. The agencies and my office have the responsibility to examine the proposed project in light of six criteria: (1) the value and usefulness of the project to be served by the dredging, (2) the effect of the proposed dredging on the use of the water by the public, (3) the value and enjoyment of the property of any riparian owner, (4) public health, safety and welfare, (5) the conservation of private and public water supply, (6) the conservation of wildlife, and freshwater, estuarine, or marine fishes. If the Depart-

ment of Conservation and Development, in view of the comments of all interested agencies, believes the project is contrary to the public interest, the permit shall be denied.

There are several problems associated with the present North Carolina dredge and/or fill law. First, it is too piecemeal. This is because each application must be considered individually and considerable time and money must be expended by both the State and private citizens to deal with this problem. Second, at the present time, there is no accurate inventory of the resources in the 2.2 million acres of North Carolina's estuarine lands. Finally, the law calls for the Department to make a ruling as to whether the proposed modifications are in the public interest. The North Carolina Supreme Court has recently ruled that only the General Assembly can determine what is or is not in the public interest. Our legislature is currently considering a rewording of the law to repair this flaw.

In 1969, the General Assembly directed the Commissioner of the Division of Commercial and Sports Fisheries to develop a comprehensive study of the estuaries of North Carolina. The study would form the basis for the preparation of a comprehensive and enforceable plan for the conservation of the resources of the estuaries, the development of their shorelines, and the use of the coastal zone of North Carolina. Through this study, on which I have filed an interim report with the Governor which is to be presented to the 1971 Session of the General Assembly, we hope to provide the State with an overall framework for a land use plan. It will be a plan into which the various biophysical, socioeconomic, and institutional components of the estuarine ecosystem may be fitted. Such a framework will allow the weighing of one demand on the estuarine zone against another and will alleviate the piecemeal, case-by-case making of decisions.

As we indicated, the State of Massachusetts passed a dredge and fill law in 1963. Through their experiences, they determined their law, also, was too piecemeal. Thus, in 1965 they enacted a law giving the Department of Natural Resources the authority to issue, upon the approval of the Board of the Department of Natural Resources,

an order which would regulate, restrict, or prohibit dredging, filling, removing or otherwise altering coastal wetlands.

The Commissioner of Natural Resources, prior to adopting an order under this Massachusetts statute, is required to hold a public hearing in the municipality where the wetlands are located. Notice must be given to State agencies as well as the assessed owner of the wetland at least 21 days prior to the hearing. If such an order is issued, it will be recorded in the register of deeds office in the district where the land is located. The statute permits the landowner to object to the order and to appeal to the Superior Court within 90 days to determine whether the order unduly restricts the use of his property so as to deprive him of a reasonable use of it, thereby making the order an unreasonable exercise of the police power. If the court feels that the order is an unreasonable exercise of police power, then the order shall be adjudged not applicable to that particular petitioner, but will not affect any land other than that of the petitioner.

We in North Carolina are presently drafting legislation, to be introduced in this session of the General Assembly, to authorize a similar authority for North Carolina. If enacted, this will give us the necessary authority and controls to consider on a coast-wide basis the effects of dredge and/or fill operations.

The comprehensive estuarine study we are presently involved in will provide the necessary background data for making these decisions regarding dredging and filling.

Another aspect North Carolina is pursuing is the purchase of estuarine areas. The 1969 session of the North Carolina General Assembly appropriated \$500,000 to be used for acquisition for endangered estuarine areas or estuarine areas that were determined to be necessary to perpetuate a healthy coastal fishery, if such lands were found to be in private ownership. To date, we have made no purchases as our other powers have been satisfactory for protecting estuarine habitat.

Another characteristic feature of the natural estuarine ecosystem, adversely affected by man, is coastal sand dune systems. These, too, can only be preserved through the institutional environment.

Sand dunes are a prominent coastal feature. In an aerial view of the coast, it is easy to distinguish fossil dunes located inshore from the surf, and in many cases covered with trees. Sand dunes located very near the surf zone are the recent and active ones and serve as a barrier and protective device for the coastal area. All experts in shoreline dynamics agree that a strong, well-vegetated dune system is a major source of protection against erosion and storm damage.

With the increase in population pressure in the coastal area and growing demands to provide second homes and beach cottages, it has become a commonplace practice to level sand dunes. The fill material is used to bring to grade land for houses and trailer parks. The removal of these natural protective structures exposes the beach strand and the inshore lands to the full force of storm tides and hurricane winds. The resulting damage from this unwise practice has prompted many states to take action to prohibit further destruction and weakening of dune systems.

Ian McHarg, in his book "Design With Nature," devotes a chapter to development in coastal areas. He spells out in detail some of the natural laws that should not be violated in developing beaches. For example, he points out the fact that developments between the dune line and the ocean are very short lived. He further stresses that if dunes are removed, or if their protective vegetation is destroyed or removed, or if the water level is lowered so that the dune cannot receive adequate moisture to support protective vegetation, then the protection afforded by the dune will rapidly disappear.

In North Carolina, we have one law that specifically addresses itself to sand dune protection. The statute is a county-enabling act and it prohibits the destruction and alteration of sand dunes without obtaining a permit from the board of county commissioners. This law provides for the establishment of a shore protection line, and a permit must be obtained before any alteration of the sand dunes seaward of this line is permitted. A shoreline protection officer, designated by the county commissioners, is given the responsibility of administering the law. He is required by statute to look at the proposed alteration to determine whether such work would materially weaken

the dunes so as to destroy the protection afforded by them. If such activity would result in damage to the dunes system, then the permit must be denied. To date, only two counties have enacted this ordinance and it is too early to tell how effective it will be in protecting sand dunes in these counties. It is obvious that the law is not effective in the other six coastal counties that do not comply with this ordinance. It has been recommended that the 1971 General Assembly amend the statute giving the counties until January 1, 1972, to take the necessary action under this statute to protect their sand dunes. If they have not acted by then, the legislation proposes that the State Department of Water and Air Resources assume control of sand dune protection.

An additional loophole exists in this statute in that the authority for establishing sand dune protection applies only to counties and not to incorporated municipalities. Thus destruction, modification, or alteration of sand dune systems may occur therein and be beyond any authority of this statute and the county commissioners. It therefore seems most likely that it will be necessary for the State to assume the authority for the protection of sand dunes when local governments cannot prevent their continued destruction.

We will now consider the third item listed as a component of the estuarine ecosystem, the institutional environment. What changes in our institutional practices can be made in order to protect estuaries? Inasmuch as man-made changes appear to be directional, we must proceed to insure that destruction and alteration of the estuarine ecosystem is minimized. There are a variety of pathways that we can follow to assure that the effects of alterations are minimized. One, for example, involves concentration on research programs that actually seek to restore damaged ecosystems. Notable success has been achieved in North Carolina in repairing both salt marsh and sand dune ecosystems. For example, programs of planting and fertilizing have been developed that permit stabilization of shifting and damaged sand dunes and even the construction of new dunes where existing ones have been completely removed. These reconstructions are based on ecological data from the dune environment and con-

sist of efforts to utilize natural forces in order to repair the system in question. The results have been sufficiently dramatic so that stabilization with grass is incorporated as a design criterion in artificial nourishment projects now recommended by the U.S. Army Corps of Engineers.

Our research has shown that it is possible to build dunes with vegetation alone, provided that there is adequate moving sand on the beach. Plants can be set with a modified tobacco planter very quickly and efficiently, provided that the original topography is relatively subdued. On existing dunes, planting must be done by hand. Our research has shown that American beach grass (*Ammophila breviligulata*) is the most desirable species for initial planting. It begins growth in the early spring, because it is a northern species, and can build a stabilized protective dune within three years. Evidence from field experiments indicates that Sea oats (*Uniola paniculata*), the native species along virtually all of the North Carolina coast, will eventually replace American beach grass. This appears to be due to the fact that Sea oats is more drought tolerant and can better tolerate the extremely high temperatures encountered during mid-summer on our coast. Our research has developed a superior strain of American beach grass, called "Hatteras," that is recommended for initial stabilization plantings along our entire coast. Sea oats will replace these plantings naturally without any damage to vegetative cover on the protective dune. Planting should be done during the late fall or early winter and plantings should always be fertilized during at least the spring and fall with a nitrogen-phosphorous fertilizer. We have extended this concept from dunes to stabilization of dredge spoil. Here, by utilizing the native salt marsh grass, *Spartina alterniflora*, it has been possible both to stabilize spoil and to re-create, in a sense, new salt marsh that can compensate for some of the marshes that have been destroyed. The result will be, hopefully, diminished needs for dredging and increased acreages of productive new marsh. From these examples, and others described in this program, we can conclude that restoration of at least portions of the estuarine system are technically quite feasible.

However, we wish to concentrate on another aspect of the recovery problem and that is, very simply, insuring that there is as little destruction as possible of our remaining estuarine areas. The most promising approach is to maintain the remaining estuarine areas that we have and to prevent future deterioration through use of man-made control systems and through proper enforcement of laws that now exist. We feel that this can be accomplished.

A new trend that shows significant promise in this direction is employment of the Public Trust Doctrine. This Doctrine is rooted deeply in English common law and Roman law. Professor Joseph L. Sax in an article considering this matter, states the approach taken in the United States as follows: "Our system has adopted a dual approach to public property which reflects both the Roman and the English notion that certain public uses ought to be specifically protected. Thus, for example, it has been understood that the sea-shore between high and low tide may not be routinely granted to private owners as was the general public domain under the Homestead Act and similar laws. It has rather been a general rule that land titles from the federal government run down only to the high water mark, with title seaward of that point remaining in the states, which upon their admission to the Union took such shore lands in 'trusteeship' for the public." This in essence says that the State has at no time had the right to transfer lands below the high tide mark to private ownership. But, in many states this has been done, generally by act of the legislature. The legality of such transfers is a matter that will have to be settled by the courts. However, even if it is determined that specific transfers of submerged lands below the high tide mark were permissible and that the States have acted within proper legal confines, then the public trust doctrine can still be of value.

In transferring land to private ownership, it can be argued that the title carries with it certain restrictions because these lands possess a greater value to the public. Therefore, this public interest must be maintained and protected. The restrictions would allow for a wide range of activities to be conducted upon the land, but others

would be prohibited. Those to be prohibited would be, we suspect, permanent alterations such as dredging and/or filling since these would remove the land from its natural and historic use in the production of fish and wildlife resources, a resource that has been documented in numerous court cases to be the property of the public at large.

There is some indication of the direction in which the federal courts appear to be heading. On July 16, 1970, the Fifth Circuit Court of Appeals handed down a decision in the case of *Zabel vs. Tabb*. This case dealt with a dredge and fill project in the navigable waters of Boca Ceiga Bay in Tampa, Florida. The Army Corps of Engineers, after considering an application for dredge and/or fill work in the navigable waters of Boca Ceiga Bay, denied a permit. The denial was not on the traditional navigational grounds, but rather was based on ecological factors including damage to fish and wildlife resources.

The Fish and Wildlife Coordination Act of 1958, under which this decision was rendered, required that the Secretary of the Army consult with the U.S. Fish and Wildlife Service before issuing a permit for dredge and/or fill operations. The U.S. Fish and Wildlife Service objected to the project and the Corps of Engineers denied the permit. The petitioners brought an action in the U.S. District Court in the lower district of Florida, contending that the Corps of Engineers had no power to consider anything except interference with navigation. The District Court apparently agreed with the petitioners' reasoning and issued a judgement against the Corps of Engineers requiring them to issue the permit. The Corps of Engineers appealed the decision to the Fifth Circuit Court of Appeals. This court reversed the District Court's decision and rendered judgement for the Corps of Engineers. The Fifth Circuit Court ruled that, in view of the Fish and Wildlife Coordination Act of 1958, the Corps of Engineers had a duty to submit dredge and/or fill plans to the Fish and Wildlife Service, and that, because of the Environmental Protection Act of 1969 (which directs every federal agency to consider ecological factors when dealing with activities which may have an impact on man's environment), the Corps of Engineers properly denied

the permit. The developers then appealed to the U.S. Supreme Court. The Supreme Court denied the appeal, thus in effect upholding the ruling of the Fifth Circuit Court of Appeals. Even though this case is only binding on the Fifth Circuit Court, the refusal of the Supreme Court to hear this case gives an indication of the direction in which it is leaning with regard to activities in coastal wetlands.

The U.S. Army Corps of Engineers, Wilmington District, with whom we work, is in the Fourth Circuit Court jurisdiction instead of the Fifth where the decision was handed down. However, the Wilmington District has indicated that they are going to follow the guideline set forth by the Fifth Circuit opinion and take a closer look at the ecological effects of dredge and/or fill projects. In view of this case, and other activity of the federal government, it appears there is going to be more federal intervention in the estuarine area in the United States.

At the State level, there is also activity related to restrictions on alterations in estuarine areas. In *Commissioner of Natural Resources et al vs. S. Volpe and Company, Inc.* [349, Mass. 104, 206 N. E. 2d (1965)], a suit was brought by the Massachusetts Commissioner of Natural Resources and Director of Marine Resources to enjoin the developer of a coastal marsh fill project. The project was part of a plan for construction of houses with water rights for boating in an existing channel, with basins to be improved by dredging. The fill project would have violated a condition imposed by the Director against the filling of marsh under the Massachusetts dredge and fill permit statute. The defendant claimed that no use of any value could be made of the land without filling. The case was remanded by the Supreme Court of Massachusetts to be reconsidered in the lower courts for additional findings of fact. Advisors to the Commissioner of Natural Resources in the appellant court, having encountered a highly unfavorable trial judge upon remand of the case, concluded that the best course of action was to drop the case. Since that time, the rule-mak-

ing statute has been enacted in Massachusetts. The Department of Natural Resources now regards this statute as a far better vehicle for implementing its program objectives than the older dredge and fill permit statute.

In attempting to manage the coastal area wisely, the most promising avenue whereby this can be achieved is through the development and enforcement of reasonable laws and regulations. It is not an unbearable restriction to require that a person who wishes to develop in the coastal area put his housing development on the natural highlands, and that residents who desire water access build walkways out across the marsh to the natural channel, this requiring no filling. It is not an undue request to make of a land developer that he place all spoil materials removed from the high land behind dikes to prevent their reentry into the waterways and that these materials not be allowed to cover, destroy, or remove marsh lands from their productive state. It is not an unreasonable request to make of a developer that he obtain his water supply from a regionalized water system and not directly out of the ground, thus causing a lowered water table and death of protective vegetation or salt-water intrusion into the water source. It is not an unreasonable request to make of the developer that he properly treat the sewage effluent generated in his housing development and transfer it to a regionalized sewage treatment facility. It is not an unreasonable request to make of a developer that he leave the sand dunes intact to provide natural protection from the sea. All of these restrictions are in accord with ecological processes and are designed to protect and perpetuate the very environment the developer uses to attract people to his development! In essence, we are saying that man's institutions must exert controls that require him, as Ian McHarg has beseeched, to "Design With Nature." In all instances of which we are aware, when man has attempted to design against nature, the result has been a thorough and resounding defeat for man. We must live with, and design with, nature if the estuarine ecosystem is to remain viable.

The ASB

BULLETIN

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Lampsilis splendida (Lea 1838)

L. siliquoidea (Barnes 1823)

See page 138 — A Brief Field Guide to the Fresh-Water Mussels of the Savannah River System

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CONTENTS

Association Affairs

Emeritus Status in ASB	138
Travel Awards for Graduate Students	147
Association Research Prize	148
Ivey F. Lewis Fellowship at Mountain Lake Biological Station	148
Suggested Nominees for ASB Offices and Executive Committee Positions	148
Meritorious Award Nominations	148
A Brief Field Guide to the Fresh-Water Mussels (Mollusca: Bivalvia: Unionacea) of the Savannah River System. — by Samuel L. H. Fuller	139
Earl L. Core, Recipient of Meritorious Teaching Award — 1971	149
Abstracts Inadvertently Omitted from April, 1971, ASB Bulletin	
Limnological Studies of Okefenokee Swamp. — Fred. K. Parrish	150
Photoperiodic Control of the Fattening Response to Prolactin in <i>Fundulus grandis</i> . — M. M. Joseph and Albert H. Meier	150
Officers and Committee Members of the Southeastern Section of the Botanical Society of America	150
News of Biology in the Southeast	151

THE COVER

Preserved examples of *Lampsilis splendida*, a southern Atlantic drainage species of fresh-water mussel, and *L. siliquioidea*, essentially of the Mississippi basin. Shell characters of each intergrade with those of *L. radiata* (Gmelin 1791), a northern Atlantic drainage species which — on conchological grounds — may link the three into a widespread, clinal "superspecies." Yet the mantle of *L. splendida* (rough, uniformly and darkly pigmented, weakly papillose at the margin, and without "eyespot") is utterly different from the mantle of *L. siliquioidea* (smooth, streaked, strongly papillose at the margin, and with "eyespot"). We do not yet know if mantle morphology and pigmentation of *L. radiata* intergrade with those of either or both of the other two species. The importance of lifelike preservation in systematic studies is apparent.

ASSOCIATION AFFAIRS

Emeritus Status in ASB

During the years, much time has been spent in executive committee meetings on the problem of keeping an up to date list of Emeritus Members. According to the Constitution and By-laws of ASB, there are two kinds of members, Active and Emeritus. An Emeritus Member has the same rights and privileges as does an active Member except that he or she does not pay dues. For this reason, the Treasurer of ASB is particularly anxious to have an accurate list of emeritus members. Since the constitution states that a member "may be elected" an Emeritus Member, the im-

(Continued on page 147)

A Brief Field Guide to the Fresh-Water Mussels (Mollusca: Bivalvia: Unionacea) of the Savannah River System

SAMUEL L. H. FULLER

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Since they feed on micro-organisms and suspended organic matter (Churchill and Lewis, 1924: 468), fresh-water mussels (or "naiades") make a major contribution to the natural cleanliness of aquatic environments. Extremely susceptible to the effects of increased siltation and disposal of man's bodily, agricultural, and industrial wastes, mussels are sensitive "indicator organisms" in studies of environmental change (see, e.g., Bates, 1962). As large and easily sampled organisms, they are admirably suited to experimental work in the life sciences.

The value of mussels, then, is undeniably great, but in many areas they are exterminated or dwindling because of pollution; overkill for

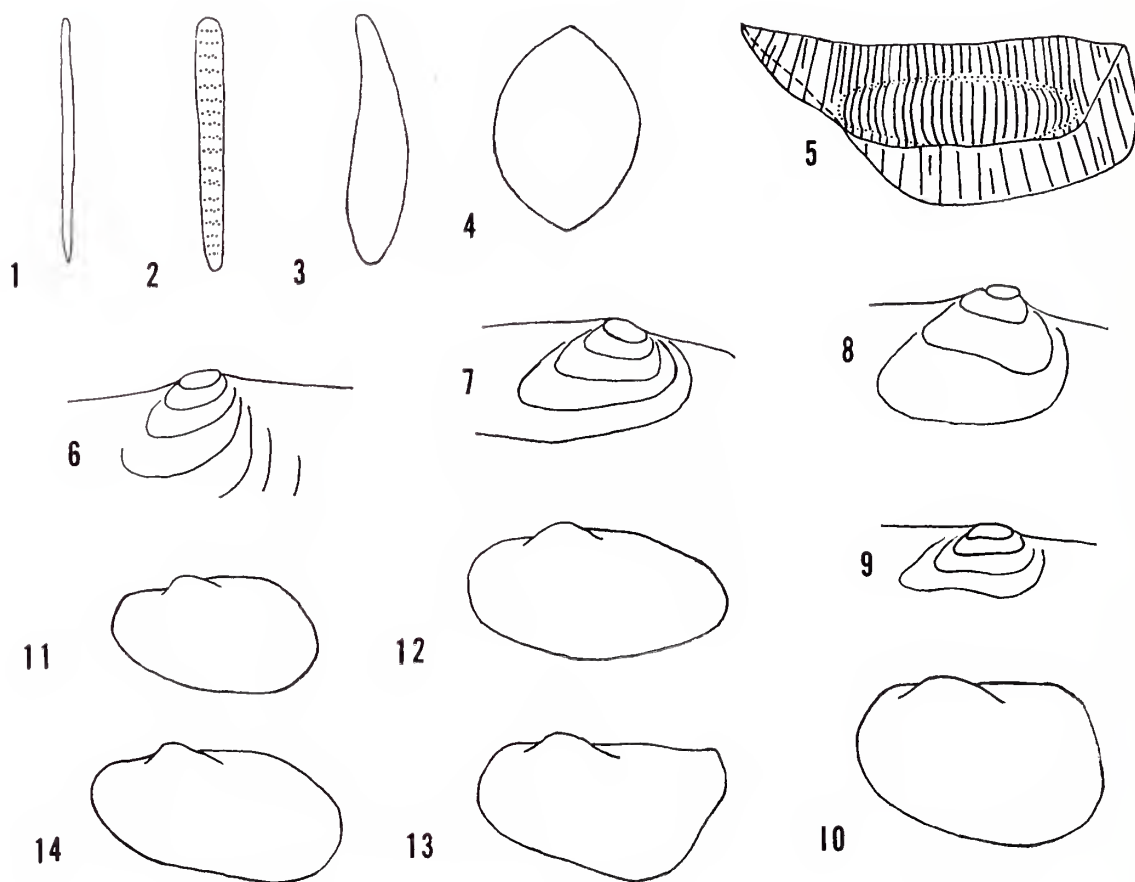
commercial and, in some instances, research purposes; and more subtle abuse, such as damming and channelization of streams, which restrict the habitats and ranges of host fishes of naiad larvae. This last item is of particular importance because we do not know the identity of a single larval host employed by a single mussel species in a single river system of the southern Atlantic drainage. Neither this nor any other opportunity for research aimed at conserving the mussel resource can be exploited until easy and accurate determination of living material is feasible.

Pennak (1953), Heard (1968), and Valentine and Stansbery (1971) have provided keys which

include all naiad genera in the southern Atlantic drainage — excepting those unnecessarily proposed by Morrison (1966) — and Johnson (1970) added a conchological key to relevant species. These contributions are all useful, but each is based in some degree upon internal aspects of the shell and anatomy which cannot be examined without injuring or killing the organ-

ism. Gratuitous destruction must be avoided lest the lives of a sampled population and of experimental work which depends upon it both come to an end. The latter is impractical; the former, ecologically indefensible.

In view of these considerations, there is need of a "field guide" approach to determination of fresh-water mussels. The key offered below is



FIGURES 1-14.—Some features of Savannah River system unionaceans.

Figs. 1-4, egg masses in anterior view (about $4\times$): 1, *Fusconaia masoni*; 2, *Unio merus tetralasmus*; 3, *Elliptio complanata*; 4, *E. icterina*.

Fig. 5, right gill of *E. icterina*, showing marsupium in outer demibranch (about $1\times$).

Figs. 6-9, beak sculptures (about $4\times$): 6, *U. tetralasmus* (bars oblique to dorsal margin posteroven-

trally); 7, *E. complanata* (bars subparallel to dorsal margin ventrally); 8, *Strophitus undulatus* (bars smoothly curved); 9, *Anodonta cataracta* (younger bars "double looped" ventrally). 6, left valve; 7-9, right.

Figs. 10-14, left valve lateral outlines (about $0.5\times$): 10, *Lasmigona subviridis*; 11, *S. undulatus*; 12, *Villosa delumbis* (male); 13, same (female); 14, *V. vibex* (female).

designed to facilitate specific determinations according to external characters of shell and mantle margin. Illustrations of shells in Johnson (1970) will be of help, and the mantle margin is readily examined in the field if specimens are allowed a few minutes to resume normal functions in a shallow vessel of water from their habitat. Occasionally the key mentions features of the egg mass, marsupium, or beak sculpture if these are useful; the gravid marsupium is easily observed when the valves are (*gently*) prised apart, and the trauma of capture often elicits expulsion of egg masses. However, beak sculpture is usually badly damaged, many species' marsupia are uncharged for much of the year, and many have a loose egg mass which does not retain its form when expelled—consequently, these characters are not essential to use of the key. Unfortunately, there *are* rare instances when examination of internal characters may be necessary; here the investigator is obliged to compromise rigid conservation by sacrificing an individual to taxonomic understanding of its population.

This communication owes much to the important effort by Johnson (1970), who pruned most of the taxonomic thicket that has been a deterrent to increased understanding of southern Atlantic drainage naiades. Ortmann's (1911) account of mussel anatomy serves as a guide to most terminology used herein. Restriction of the paper's scope to species found in the Savannah River system reflects the author's strengths at this time. Correspondence with W. H. Heard aided materially in framing ideas advanced below concerning the systematic position of *Uniomerus*. Great thanks are due R. Robertson, who permitted examination of material in the Academy's collections, and C. W. Hart, Jr., who suggested and implemented its appearance in this journal. Any errors are the author's, however, and constructive criticism is solicited.

PHYLOGENETIC LIST OF SAVANNAH RIVER SYSTEM UNIONACEA

Classification of the superfamily Unionacea (as restricted by Parodiz and Bonetto, 1963) above the generic level has been disputed for decades. Although there are excellent alterna-

tives (e.g., Heard and Guckert, 1971), each poses unresolved problems, and the familiar (and worthy) scheme of Ortmann (1910, 1911, 1912) is used here.

Superfamily Unionacea

Family Unionidae

Subfamily Unioninae

Elliptio congaraea (Lea 1831)

E. complanata (Lightfoot 1786)

E. lanceolata (Lea 1828)

E. icterina (Conrad 1834)

Subfamily Anodontinae

Lasmigona subviridis (Conrad 1835)

Alasmidonta triangulata (Lea 1858)

A. varicosa (Lamarek 1819)

Anodonta cataracta Say 1817

A. imbecilis Say 1829

A. couperiana Lea 1840

Strophitus undulatus (Say 1817)

Subfamily Lampsilinae

Carunculina pulla (Conrad 1838)

Villosa vibex (Conrad 1834)

V. delumbis (Conrad 1834)

Lampsilis splendida (Lea 1838)

L. cariosa (Say 1817)

L. ochracea (Say 1817)

Omitted from this list are the following taxa of uncertain systematic position or specific validity.

1. *Uniomerus tetralasmus* (Say 1831) appears to survive a stage in unionacean evolution when discontinuous elements of interlamellar connecting tissue had recently fused to form complete vertical septa and water tubes (transverse thickened areas of the egg mass correspond to broad grooves in the septa where adjacent elements are linked by thinner tissue). The antiquity of this genus is additionally suggested by its enormous tenacity of life (first remarked by Simpson, 1893: 429), widespread distribution (Johnson, 1970: 341), dendritic branchial papillae, narrow gape of the valves in life, unique beak sculpture (Fig. 6), and narrow egg mass (see remarks on *Fusconaia masoni* below).

The dorsally perforate septa and tetragenous marsupium of *Gonidea angulata* (Lea 1838) (Ortmann, 1916) led Heard and Guckert (1971)

to create the new subfamily Amblemidae: Gonideinae. The imperforate septa and digenous marsupium of *Uniomereus* mean that it cannot be included in Gonideinae as presently defined, but the unique properties of the genus require suprageneric recognition. An appropriate taxon (or concept thereof) has not been proposed, and *Uniomereus* cannot be accurately classified within any existing system of the naiades at this time.

Populations of *Uniomereus* from the Atlantic drainage and from the Mississippi basin appear to differ only in that the latter have a tendency toward minute papillation of the mantle margin before the branchial aperture. I am presently inclined to favor Johnson's (1970: 339) decision to consider all *Uniomereus* conspecific under the well known name *tetralasmus*, as opposed to a more liberal interpretation of the genus by Valentine and Stansbery (1971: 22).

2. Like *Uniomereus tetralasmus*, *Fusconaia masoni* (Conrad 1834) reflects a period when unionacean septa and gill walls were rather inelastic (thus restricting incubative capacity for ova and glochidia), but inelasticity in this genus is so great that water tubes are much more narrow than in *Uniomereus*, thereby creating a subcylindrical egg mass (Fig. 1). No suprageneric taxon exists in recognition of this evolutionary stage.

3. *Elliptio fraterna* (Lea 1852) and *E. arcata* (Conrad 1834) are eastern Gulf drainage natives recorded by Johnson (1970: 313, 333) from the Savannah system. I am not convinced that in the Atlantic drainage these taxa can be distinguished from *E. congaraea* and *E. lanceolata*, respectively, and they are not included in the key below.

KEY TO SAVANNAH RIVER SYSTEM UNIONACEA

- 1a Anal papillae not fused together for their entire lengths 2
- b Anal papillae completely fused (distal margin of inner mantle lobe smooth at anal aperture) Anodontinae, 8

Diagnoses of anodontine genera depend chiefly upon internal hinge characters; these are used in couplets 8-13 for the sake of absolutely certain determination of specimens with confusing external characters, but the accompanying notes facilitate specific identification without regard to generic position.

- 2a (1) Most branchial papillae dendritic 3
- b Most branchial papillae simple 4

- 3a (2) Distal margin of inner mantle lobe erenulate at anal aperture; animal essentially whitish; marsupium digenous (only outer demibranchs marsupial); egg mass narrow with transverse grooves (Fig. 2) which correspond to ribs on the septa .. *Uniomereus tetralasmus*

Cloth-like periostracum and the conspicuously angled junction of the dorsal and posterior margins combine to identify most *U. tetralasmus*, but external shell characters will not separate this species from certain ecophenotypes of *Elliptio* when the respective beak sculptures (Figs. 6, 7) are destroyed. However, *U. tetralasmus* is easily distinguished from any *Elliptio* because of (a) the color of the outer surface of its mantle margin (slate gray, replaced by brown at the apertures) and (b) the combination of dendritic branchial papillae and almost completely fused anal ones.

- b Fusion of anal papillae minimal or negligible (an outer row of smaller papillae may usually be distinguished from an inner row of larger ones); animal usually a vivid orange or red; marsupium tetragenous (all demibranchs marsupial); egg mass subcylindrical (Fig. 1) *Fusconaia masoni*
- None of these characters occurs in *Elliptio congaraea* (choice 5a) or *Alasmidonta triangulata* (10a), the only southern Atlantic drainage species apt to be superficially confused with *F. masoni*. The closely related *Lexingtonia subplana* (Conrad 1837) has been verified in only the James River system of Virginia (Ortmann, 1914).
- 4a (2) Mantle margin without papillae before branchial aperture; shell without conspicuous sexual dimorphism Unioninae, *Elliptio*, 5
- b Mantle margin with papillae before branchial aperture; shell with conspicuous sexual dimorphism (Figs. 12, 13, 14) Lampsilinae, 14
- Reduced or wanting in the male, characters employed in couplets 14-18 are those of the female.
- 5a (4) Length about $1.5 \times$ height; distal margin of inner mantle lobe at anal aperture with a single row of minute processes of about equal lengths *Elliptio congaraea*
- Several closely allied southern Atlantic drainage taxa recognized by Johnson (1970), including *E. congaraea*, bear a derivative or conspecific relationship to *E. crassidens* (Lamarck 1819) of the Gulf drainage and Mississippi basin. The robust shell and the nature of the anal papillae are the unifying features of this complex, whose natural taxonomy possibly will depend upon immunological analysis or some such nonmorphological tool. Members of this group are distinguished superficially from *Unionerus tetralasmus* in that the latter's anal papillae are represented only by crenulations of the inner mantle lobe (which may be almost as smooth distally as in the Anodontinae) and its branchial papillae are dendritic. See *Fusconaia masoni* (choice 3b) and *Alasmidonta triangulata* (10a).
- b Length conspicuously more than $1.5 \times$ height; usually two rows of anal papillae, whose free portions vary greatly in length 6
- 6a (5) Length about $3 \times$ height *Elliptio lanceolata*
- Older and deformed individuals tend to resemble other *Elliptio*, but juveniles retain the characteristic elongation of this species, which often exhibits very little fusion of the anal papillae, plus dark and extensive pigmentation of the papillae and mantle about the apertures.
- b Length about $2 \times$ height 7
- 7a (6) Mantle and papillae heavily and extensively pigmented at apertures; gravid marsupium a thin pad extending the full length and height of the outer demibranch; egg mass elongate and usually slightly curved (Fig. 3); beak sculpture consisting of several low bars *Elliptio complanata*
- b Mantle and papillae neither heavily nor extensively pigmented at apertures; gravid marsupium swollen and extending only to the ventral margin of the outer demibranch (Fig. 5); egg mass broadly suboval (Fig. 4); beak sculpture consisting of several low bars weakly tuberculate at posterior ridge *Elliptio icterina*
- Sharply contrasting degrees of marsupial elasticity are enough to demonstrate that *E. complanata* and *E. icterina* are profoundly different biological entities. Unfortunately, they are ordinarily the two Savannah system species that are most difficult to separate because (a) the marsupia are fully charged in only late spring and summer, (b) the typically very different pigmentation of papillae and adjacent mantle is rather variable, and (c) the beak sculptures are usually corroded. Ironically, these are also the two most abundant and widespread

species in the system and, therefore, most apt to figure in biological investigation. Typically, the *complanata* shell is larger, heavier, more nearly rectangular, and has much darker and rougher periostracum; these differences are most pronounced in rivers and larger creeks, and the very large, laterally compressed *Elliptio* of the Savannah proper seems always to be *complanata*. Nonetheless, until more is learned about the two species, their separation will be impracticable in many instances.

- 8a (1) Lateral teeth present *Lasmigona subviridis*
The ventral margin is greatly descendant behind, and the dorsal and posterior margins meet in a distinct angulation. These features combine to give *L. subviridis* a unique lateral outline (Fig. 10), but large specimens with roughened periostracum can be mistaken for *Elliptio*, whose anal papillae are incompletely fused.
- b Lateral teeth absent 9
- 9a (8) Pseudocardinal teeth present *Alasmidonta*, 10
b Pseudocardinal teeth absent 11
- 10a (9) Beaks raised prominently above dorsal margin; posterior ridge sharp; posterior slope without sculpture *Alasmidonta triangulata*
In the southern Atlantic drainage, this species can be confused with only *Fusconaia masoni* (choice 3b) and *Elliptio congaraea* (5a), both of which have incompletely fused anal papillae.
- b Beaks raised slightly above dorsal margin; posterior ridge broadly rounded; posterior slope with radial wrinkles *Alasmidonta varicosa*
This is the only southern Atlantic drainage species with a consistently sculptured posterior slope. An occasional *Elliptio congaraea* (choice 5a) has a faintly wrinkled slope, but its incompletely fused anal papillae and much greater height relative to length separate it from *A. varicosa*.
- 11a (9) Hinge swollen and sharply descendant before beaks *Strophitus undulatus*
The undulation of the dorsal margin at the beaks causes its anterior portion to lie at a level much lower than the posterior. The characteristic lateral outline (Fig. 11) separates *S. undulatus* from *Anodonta cataracta*, whose hinge is more or less straight. However, atypical living examples of the two can be inseparable when their beak sculptures (Figs. 8, 9) are destroyed. Completely fused anal papillae distinguish either species from *Elliptio*.
- b Hinge uniformly narrow and nearly straight *Anodonta*, 12
- 12a (11) Beaks raised above dorsal margin *Anodonta cataracta*
See *Strophitus undulatus* (choice 11a). *A. gibbosa* Say 1824 is distinguished from *A. cataracta* by an oblique bulge that runs the height of the shell just before the posterior ridge. Frierson (1912) thought the two taxa perhaps only varietyally different; Johnson (1970) considered them distinct species but restricted *gibbosa* to the Altamaha River system of Georgia, which has several unionacean endemics. Some Savannah material resembles *gibbosa* much more closely than *cataracta*, and *gibbosa* may prove to occur in this system.
- b Beaks not raised above dorsal margin 13
- 13a (12) Ventral margin deeply convex; periostracum finely rayed *Anodonta couperiana*
b Ventral margin weakly convex or straight; periostracum broadly rayed *Anodonta imbecilis*
These two *Anodonta* are the only southern Atlantic drainage naiades whose beaks do not extend above the dorsal margin.

- 14a (4) Mantle margin with caruncle (a lump or thick papillation) before branchial margin *Carunculina pulla*

 Johnson's (1970: 371) only Savannah system record is from the type locality of *C. patrickae* Bates 1966, which may be synonymous with *C. pulla*. The caruncle is unique to this genus.
- b Mantle margin without caruncle 15
- 15a (14) Mantle margin with flap before branchial aperture *Lampsilis*, 16
 b Mantle margin without flap *Villosa*, 18
- 16a (15) Mantle margin pigmentation and flap greatly reduced *Lampsilis ochracea*
 Essentially a tidewater species, *L. ochracea*—like the ecologically comparable *Anodonta implicata* Say 1829 (see Davenport and Warmuth, 1965)—may be parasitic on an anadromous fish. Perhaps the de-emphasized generic characters reflect reduced need to attract the host inasmuch as densely schooling fish, including anadromous species, are especially liable to glochidial infection. This mussel can be confused with juvenile *L. cariosa* in lower portions of river systems, but differentiation and pigmentation of the mantle margin differ greatly in each.
- b Flap well developed; mantle margin deeply and extensively pigmented 17
- 17a (16) Shell outline suboval; periostracum smooth and yellowish; mantle margin smooth and with dark longitudinal streaks on lighter ground *Lampsilis cariosa*
 See *L. ochracea* (choice 16a).
- b Shell outline subrectangular; periostracum rough and reddish to brownish; mantle margin rugose and darkly pigmented *Lampsilis splendida*
- 18a (15) Shell weakly sexually dimorphic (Figs. 12, 13, 14); periostracum brownish with rays more or less uninterrupted by narrow growth rests; mantle margin densely mottled and streaked *Villosa vibex*
 b Shell strongly sexually dimorphic (Figs. 12, 13); periostracum yellowish with rays interrupted by broad growth rests; mantle thinly mottled and streaked *Villosa delumbis*

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Course on Plant Cell, Tissue, and Organ Culture

The Tissue Culture Association offered an advanced course on PLANT CELL, TISSUE AND ORGAN CULTURE at the new W. Alton Jones Cell Science Centre at Lake Placid, N.Y., from July 12 to August 6, 1971, under the direction of Indra K. Vasil of the University of Florida. This was the first course of this kind offered in the United States and was enthusiastically received by participants from Canada, Denmark, Israel, and the United States, with training and background in biochemistry, horticulture, microbiology pharmacognosy, and plant physiology. The following taught parts of the course: Donald K. Dougall (W. Alton Jones Cell Science Centre), J. Eugene Fox (University of Kansas), William A. Jensen (University of California, Berkeley), Richard M. Klein (University of Vermont), Watson M. Laetsch (University of California, Berkeley), Joseph P. Mascarenhas (SUNY at Albany), Donald J. Merchant (W. Alton Jones Cell Science Centre), Ray A. Miller (Prairie Regional Laboratory, Saskatoon), Toshio Murashige (University of California, Riverside), E. John Staba (University of Minnesota), Tom T. Stonier (Manhattan College), Ian M. Sussex (Yale University), John G. Torrey (Harvard University), Indra K. Vasil (University of

Florida), and Vimla Vasil (University of Florida). Extensive lecture-discussion and laboratory sessions were held on such topics as past, present and future of plant tissue culture; theory and practice of aseptic techniques; physiology and cytology of plant tissue cultures; criteria for evaluation of growth in tissue cultures; morphogenesis in plants; role of plant growth substances in growth and development; nutrition of plant tissue cultures; morphogenesis and embryogenesis in vitro; culture of shoot apex, root, nucellus, ovary, ovule, embryo, anther and pollen grains; plating, suspension and mass culture techniques; nurse tissue and single cell culture; plant protoplast culture; histological and histochemical techniques; plant tumors; metabolism and enzymes in plant tissue cultures; secondary plant products in tissue cultures; development, structure and function of plastids in tissue cultures; and effect of visible and invisible radiation on plant tissue cultures.

Similar broad-based four-week courses for general background and training in plant tissue culture, as well as short-term courses on topics of special interest and application are planned for future. Topics and dates of new courses will be announced in these columns later. ■

plication is that the writers of the constitution felt that this was an honor. Some of those so elected, however, have not considered it an honor but resented being considered a "retired" rather than an "active" biologist. Some have wished to continue to contribute financially to ASB rather than be exempted from dues. Others have welcomed the opportunity to enjoy the privileges of membership without any financial responsibility.

In the collected minutes of ASB meetings, a recurring question is found — How do we discover who is eligible for Emeritus Membership? During recent discussions in executive committee meetings, the suggestion was made that the initiative be shifted to those members of ASB who are eligible for emeritus status. Therefore, it is hereby requested that those who retire "from professional duties" after ten or more years of membership in ASB should apply to the Secretary of ASB if they wish to be elected to emeritus status. The Association records will be checked, and if they are eligible, their names will be submitted at the next annual meeting for election as emeritus members as provided by Article III, Section 3 of the Constitution of the Association of Southeastern Biologists. Such a procedure will allow individuals to decide whether or not they want to be recognized as having reached emeritus status, and if anyone wishes to be an Emeritus Member and still contribute financially to the Association, the Treasurer will gladly accept gifts in any amount. Reminders of the existence of an Emeritus Membership in ASB may be sent to some members, but election to emeritus status will not take place without the consent of the party concerned. It is hoped that such a procedure will be acceptable to the membership and forestall future lengthy but fruitless discussions about how to determine who is eligible for emeritus membership.

MADELINE P. BURBANCK, *Archivist*

TRAVEL AWARDS FOR GRADUATE STUDENTS

For the fifteenth year there will be funds available for assistance to graduate students for expenses in connection with the annual ASB

meetings, to be held this year at the University of South Alabama, Mobile, Alabama. Approximately \$300 will be available, and it is anticipated that most of the awards will be for maintenance (lodging and meals), and departments are urged to provide travel allowances for their graduate students or to invite them to travel in cars with staff members. Some travel allowances may be awarded by the committee to those living most distant from Mobile.

Staff members are requested to call to the attention of qualified students in their respective institutions the availability of these awards. If there is more than one applicant from a department, the committee may request the department to aid the committee's selection by ranking the applicants.

Any graduate student needing financial assistance in order to attend the 1972 meeting of the Association of Southeastern Biologists is eligible. Rules for making application for the awards are as follows:

1. Indicate if application is being made for maintenance or travel or both. Give details, such as total sum requested, how many nights and days are involved, if travel allowance is requested, the number of miles involved and the proposed method of transportation, and any other pertinent information.
2. Give information as to whether or not a paper is being presented by the applicant.
3. In a paragraph, give a brief history of your education to date, of how many years you have been — and plan to be — in graduate school, of your major field or fields of interest, of any publications which have appeared or which may be in preparation, and any other pertinent professional details. Give information on marital status and number of children.
4. Give your source or sources of support while in graduate school such as G.I. Bill, N.S.F., N.I.H., teaching assistantship, etc.
5. Have your major professor or departmental head write a letter supporting your application.
6. Applications and supporting letters, both in triplicate, should be in the hands of *Dr. Stephen Gittleston, Dept. of Zoology, Univ. of Kentucky, Lexington, Kentucky 40506*, by 1 February 1972. Applicants will be notified of the decision of the Committee as soon as possible.

BERYL C. FRANKLIN

CLARENCE STYRON

STEPHEN M. GITTLESTON, *Chairman*

ASSOCIATION RESEARCH PRIZE

If you intend to present a paper at the annual meeting of the Association of Southeastern Biologists, we wish to call your attention to the Association Research Prize and invite you to submit your manuscript in competition. This prize is sponsored by the Carolina Biological Supply Company, Burlington, North Carolina. Rules and regulations are as follows:

1. The Research Prize is to be awarded for an especially meritorious paper actually presented at the annual meeting.

2. Only members are eligible to submit papers in competition for the Research Prize. This applies to all names on the submitted paper.

3. Papers submitted in competition may be in press but must not have been published prior to March 1 of the year of the current competition.

4. Papers submitted in competition are judged by eminent scientists in the various fields of biology. These individuals are selected by the Research Committee and are from schools outside the Southeast. Every effort is made by the Research Committee to keep the authors of submitted papers anonymous. Criteria for the award are left to the discretion of the judges' panel, who may withhold said award if no paper is considered to have sufficient merit.

5. Papers must be submitted in *triplicate* and in their entirety not later than *February 1, 1972*, to Dr. Paul Yokley, Jr., Dept. of Biology, Florence State College, Florence, Alabama, 35630. One copy of the prize-winning paper will remain in the ASB files, but all other copies will be returned to the authors as soon as possible.

6. Announcement of the winner of the Research Prize will be made at the annual meeting.

RICHARD E. GARTH

J. C. O'KELLY

PAUL YOKLEY, JR., *Chairman*

IVEY F. LEWIS FELLOWSHIP AT MOUNTAIN LAKE BIOLOGICAL STATION

A Research Fellowship of \$150.00 for summer course study or research at Mountain Lake Biological Station of the University of Virginia has been continued through the generosity of the Phipps and Bird Company of Richmond, Virginia. This fellowship, formerly known as the *Phipps and Bird Research Fellowship*, was re-named at the request of the Phipps and Bird Company. Any member of the Association may submit an

application. The application should be accompanied by a summary of the planned work, by a list of important publications, and especially in the case of younger workers, by references and educational data. Applications should be sent to Dr. J. J. Murray, Dept. of Biology, Univ. of Virginia, Charlottesville, Virginia 22903 not later than 1 March 1972. The announcement of the recipient will be made at the annual meeting of the ASB.

SUGGESTED NOMINEES FOR ASB OFFICES AND EXECUTIVE COMMITTEE POSITIONS

To the members of the Nominating Committee:

I wish to suggest that you consider the following ASB members in selecting nominees for offices and executive committee positions:

PRESIDENT-ELECT

VICE-PRESIDENT

EXECUTIVE COMMITTEE MEMBERS (2 for 3-year terms)

Deadline: December 15

MAIL TO: DR. ROBERT SHORT
Dept. of Biological Sciences
Florida State University
Tallahassee, Florida 32306

MERITORIOUS AWARD NOMINATIONS

As in previous years, an ASB member will be recognized for especially meritorious teaching at the April meeting. The regulations governing the award are as follows:

The recipient must be a member of the ASB in good standing. He should have taught biology in a southern institution for at least ten years, and must be currently teaching. He must not be a dean or have regular administrative duties beyond the department level (this particular criterion requiring interpretation in individual cases). Among evidences of his qualifications is the progress of the candidate as indicated by recognition in his own institution (important assignments and other contributions specifically related to good teaching); and the number and quality of students for whom he provided primarily the inspiration to continue in biology, especially those who later received advanced degrees.

Past recipients of the Meritorious Award for Teaching are as follows:

1952. Dr. Mary Stuart MacDougall (Agnes Scott)
 1953. Dr. Orland E. White (Univ. of Virginia)
 1954. Dr. Woolford B. Baker (Emory)
 1955. Dr. John N. Couch (Univ. of North Carolina)
 1956. Dr. Hugo L. Blomquist (Duke)
 1957. Dr. Ezda Deviney (Florida State)
 1958. Dr. Henry R. Totten (Univ. of North Carolina)
 1959. Dr. Margaret Hess (Winthrop College)
 1960. Dr. Ora. C. Bradbury (Wake Forest College)
 1961. Dr. Warren Deacon (Vanderbilt)
 1962. Dr. Septima C. Smith (Univ. of Alabama)
 1963. Father Patrick H. Yancey (Spring Hill College)
 1964. Dr. Ruskin S. Freer (Lynchburg College)
 1965. Dr. Harwell P. Sturdivant (Western Maryland College)
 1966. Dr. Charles Ray, Jr. (Emory Univ.)
 1967. Dr. H. J. Oosting (Duke University)
 1968. Dr. Wade T. Batson (Univ. of South Carolina)

1969. Dr. William L. Mengebier (Bridgewater College)
 1970. Dr. Elton C. Cocke (Wake Forest University)
 1971. Dr. Earl L. Core (Univ. of West Virginia)

In these times in which so much is heard about teaching, it is particularly important that excellence in teaching should be rewarded and publicized in every way possible. Members of the ASB are urged to make nominations and send the needed supporting material to *Dr. William Mengebier, Dept. of Biology, Bridgewater College, Bridgewater, Virginia 22812.*

COMMITTEE

ROBERT T. BRUMFIELD
 STUART BAMFORTH
 WILLIAM MENGBIER, *Chairman*

Earl L. Core, Recipient of Meritorious Teaching Award - 1971

Dr. Earl L. (emley) Core has provided inspiration for thousands of students during his 44 years of teaching. He began his teaching career in public schools but after two years returned to West Virginia University, his alma mater, as an Instructor. He has remained on the staff of the Biology Department there since. He earned a Ph.D. at Columbia University in 1936. During World War II, he was Botanist of the Foreign Economic Administration's Columbian Mission for two years. From 1948 to 1967 he served as department chairman and was known by staff and students as an efficient, fair, and effective administrator. Even during his years as department chairman he maintained a full teaching load and was particularly active in teaching the freshman biology courses. His interest in the large general biology courses was emphasized when he assisted in the revision of "General Biology" by P. D. Strausbaugh and B. R. Weimer, a standard text book of the mid-century period; and in the writing of "A New Manual for the Biology Laboratory" in collaboration with B. R. Weimer. Other text books written by him are "Common Seed Plants of the Mid-Appalachian Region" (1931, with P. D. Strausbaugh and Nelle Ammons), "Plant Taxonomy" (1955), and "Vegetation of West Virginia" (1966).

His enthusiasm and dedication to teaching general biology has resulted in an interest in biology of thousands of students who got to know him in classes.

However, it is in the area of botany, and in particular, systematic botany that Dr. Core's impact as a teacher has been greatest. From 1926 to 1938 he spent his summers teaching field courses as a part of the West Virginia Biological Survey and in the summers of 1939-1941 he taught at Ohio State University's field station at Put-in-Bay. During this time hundreds of students were introduced to field work through his efforts. His courses in plant taxonomy and botany on campus were also an inspiration to many. Well over 100 of his former students have continued in the field of biology and are now teaching in colleges throughout the land. His enthusiasm for the field of plant taxonomy has resulted in over 100 publications including 10 books, the most extensive of which is "Flora of West Virginia" written with P. D. Strausbaugh.

Dr. Core's teaching and leadership abilities were recognized by his own school by the honor of being named Distinguished Professor at West Virginia University in 1967 and by his selection by recent graduates of the University, as best

teacher in the Department of Biology and as one of the four best teachers in the College of Arts and Sciences. In addition to these local honors he was awarded an honorary Doctor of Science Degree by Waynesburg College in 1957.

Notwithstanding his huge teaching commitments and research efforts, Dr. Core has also found time to found a botanical society — The Southern Appalachian Botanical Club — and to

edit *CASTANEA*, its journal, throughout its 35 years of existence. He also was influential in starting a botanical honorary society — Phi Epsilon Phi — that now has 4 chapters in the Eastern United States. His services to the community have been great. He was mayor of the city of Morgantown from 1956 to 1957 and is active in numerous community endeavors.

**Inadvertently the following abstracts were
omitted from the April, 1971, ASB Bulletin.**

Linnological Studies of the Okefenokee Swamp

FRED K. PARRISH, *Georgia State University*

Studies over the last five years in the Okefenokee Swamp have revealed a high rate of diurnal oxygen and carbon dioxide fluctuation, indicative of a high rate of productivity and community metabolism, contrary to some previous conclusions. In combination with high diurnal temperature fluctuations and other factors, conditions are created which are unique to water courses on the Southeastern coastal plain. Water probably enters the swamp from underground seepage and not in significant quantities from large springs or creeks to the northwest as has been reported previously by others. The swamp probably originated as a salt-marsh, then became a fresh water marsh, the depth of the swamp increasing because of the blocked water flow by the accumulating peat. Previous reports have considered the swamp to be a fresh water lake which filled in. The organic material found in the Okefenokee and other swamps represents significant accumulations of minerals. Since rivers have a series of such swamps along their courses, these wetlands probably represent

a series of nutrient traps which significantly delay the progress of nutrients to oceanic sinks.

**Photoperiodic Control of the Fattening Response
to Prolactin in *Fundulus grandis***

JOSEPH, M. M. AND ALBERT H. MEIER

Louisiana State University, Baton Rouge

Gulf killifish, *Fundulus grandis*, were held on three different photoperiods (8L:16D; 12L:12D; 16L:8D) and injected with ovine prolactin (2 μ g/gm B.W. in 0.02 ml 0.65% saline) at one of several times of the day for 6 consecutive days. Peak levels of liver and carcass fat stores were found in fishes which received prolactin eight hours after the onset of light regardless of whether the photoperiod was 8, 12 or 16 hours. Prolactin injections at other times of the day did not stimulate fattening. These results suggest that the endogenous system (probably the adrenal steroids) controlling the daily fattening response to prolactin is phased by the onset of light.

**Officers and Committee Members
of the Southeastern Section
of the Botanical Society
of America**

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Dr. Ray Noggle (1971-1973)
Department of Botany
North Carolina State University
Raleigh, North Carolina 27607

SECRETARY-TREASURER:

Dr. Dana Griffin, III (1971-1974)
Department of Botany
University of Florida
Gainesville, Florida 32601

MEMBERS OF ACTIVITIES COMMITTEE:

Dr. John A. Soole, Jr. (1969-1973)
Division of Science and Mathematics
Georgia Southern College
Statesboro, Georgia 30458

Dr. Gwynn Ramsey (1971-1974)
Biology Department
Lynchburg College
Lynchburg, Virginia 24504

**CHAIRMAN OF THE ACTIVITIES
COMMITTEE:**

Dr. J. M. Herr, Jr. (1968-1972)
Department of Biology
University of South Carolina
Columbia, South Carolina 29208

News of Biology in the Southeast

STATE CORRESPONDENTS

Alabama — Jack S. Brown, Florence State University; James Wilkes, Troy State University

Florida — Harold J. Humm, University of South Florida

Georgia — Fred K. Parrish, Georgia State College

Kentucky — Gary E. Dillard, Western Kentucky University

Louisiana — Harry J. Bennett, Louisiana State University

Mississippi — Position Vacant

North Carolina — C. J. Umphlett, University of North Carolina

South Carolina — J. M. Herr, Univ. of South Carolina; G. Thomas Riggan, Jr., Newberry College

Tennessee — Donald Caplenor, Tennessee Technical University

Virginia — Jean Pugh, Christopher Newport College

West Virginia — Earl L. Core, West Virginia University

Jean Pugh — Editor

Dept. of Biology

Christopher Newport College
Newport News, Virginia 23601

Wofford College biology chairman **W. Ray Leonard** has been elected first president of the newly formed South Carolina Biologists Association which includes biologists from S.C. state and independent colleges, business and industry.

The Association, which is one of the first of its kind in the nation according to Leonard, was organized "to better the teaching of biology in our colleges and universities, to encourage cooperation between schools in the teaching of the science, and to create a position where we could, as biologists, speak out on special issues and problems."

New Association officers also include, vice-president, **Dr. Harry Freeman**, College of Charleston; secretary-treasurer, **Dr. Luckett Davis**, Winthrop; editor, **Dr. Gilbert Fairbanks**, Furman; honorary past-president, **Dr. Rex Kerstetter**, Furman; and three regional councilors, Coastal, **Dr. Lewis Roach**, S. C. State College; Midlands, **Dr. David Rembert**, USC; and Piedmont, **Dr. Robert Powell**, Jr., Converse College.

Word has been received of the death of **Jacobus Marinus Lodewijks**, 60, on June 21, 1971, in The Hague, Holland. Dr. Lodewijks was former president of the World Aquarium Society and a Nature Photographer of distinction, and at the time of his death, a member of the staff of the University of Leiden. In 1957-58 he was exchange professor of Biology at Longwood College, Farmville, Virginia.

Ronald R. Cowden, Professor and Chairman, Department of Biological Sciences, University of Denver in Denver, Colorado, has been appointed Professor and Chairman, Department of Anatomy, Albany Medical College, Albany, New York 12208, effective 1 January 1972.

The Mississippi Academy of Sciences held the annual meeting at the University of Southern Mississippi in Hattiesburg, Mississippi (April 24-26, 1971). Papers were given in the Botany and Plant Pathology, Zoology

and Microbiology Sections. Interest in the Mississippi Academy has grown in the past year is evidenced by the fact that twice as many papers were presented as last year.

A Seminar on the estuarine environment supported by the National Science Foundation was conducted here at the Gulf Coast Research Laboratory May 6-9, 1971. Lectures were given by **Harry Bennett** of Louisiana State University and **Lionel N. Eleutherius** of the Gulf Coast Research Laboratory and **J. Y. Christmas**.

Memphis State University, Memphis, Tennessee

B. A. Simco received a grant of \$53,000 from the Bureau of Sport Fisheries and Wildlife for investigations of intensive culture of channel catfish in raceways.

The NSF, under the instructional Scientific Equipment Program, has awarded Memphis State \$37,000 to equip new courses in Cell and Molecular Biology and Comparative Physiology. **P.S. Rushton**, **K.B. Davis** and **J. S. Layne** are directors of the grant.

Paul R. Simonton has received \$29,288 from HEW for the continuation of an Allied Health Education Improvement Grant for Medical Technologists and Medical Record Librarians.

L. M. Outten, Professor of Biology and Ecological Research, Mars Hill College, North Carolina, continued field studies with Cambridge University in the English Lake District during the latter part of the summer.

John L. Mego of the University of Alabama, Tuscaloosa, recently received a research grant for \$81,059 from the National Institute of Environmental Health Sciences. The three year project is entitled "Effect of some environmental agents on lysosomes."

Zachary S. Wochok will join the staff of the Department of Biology, University of Alabama, Tuscaloosa, in

August. He is a plant morphogeneticist and is completing a postdoctorate at the University of Connecticut.

Ichthyologist **Herbert Boschung** and ethnobotanist **C. Earle Smith** of the Department of Biology, University of Alabama, Tuscaloosa, recently returned from a 4 week collecting trip to the Amazon and the Rio Lareto Yuca. Their travel was financed by the Alabama Museum of Natural History, and by the University of Alabama Research Grants Committee and Office of International Studies.

Herbert Boschung, University of Alabama, Tuscaloosa, has been awarded a one year research grant for \$36,000 by the U. S. Army Corps of Engineers. The project will involve a survey of the fish fauna of the upper Tombigbee River System and the Yellow Creek drainage of the Tennessee River for the purpose of establishing a base line to be used in assessing the effect of the proposed Tennessee-Tombigbee Waterway on the fish population.

The University of South Alabama has added two new Marine Biologists to the Biology staff — **David M. Dean**, who received his doctorate in Marine Biology from the University of Miami, and **Dr. Robert L. Shipp**, who received his doctorate in Marine Biology from Florida State University and most recently was a member of the faculty at Florida A & M.

Robert Tucker will join the staff of the Department of Biology, Troy State University, in September after completing his doctorate at the University of Alabama.

NSF Institutional Grants have been awarded several members of the Troy State University Biology faculty for research. **Dr. Donald Barras** and **Dr. Raymond Kisner** received a grant for research on the morphology of the digestive and internal reproductive systems of adult *Microplites croceipes*; **Mr. Wayne Adams** for studies of the electrophoresis patterns in the blood of turtles; **Dr. James C. Wilkes** for studies on gamma-irradiation of blight susceptible corn and **Dr. Danice Costes** for a taxonomic study of the subfamily *Cercopinae*. NSF funding for research under the Institutional Grants is \$20,000.

NEWS NOTE FROM THE SOUTHERN SECTION OF THE AMERICAN SOCIETY OF PLANT PHYSIOLOGISTS

The 27th annual meeting was held in Jacksonville, Florida, January 31 through February 2, 1971. Sixty seven members registered for the meeting and forty two papers were presented.

The annual symposium was entitled, "Photorespiration." The symposium was organized and chaired by **Dr. J. E. Pallas** with speakers and

their topics being: **Dr. R. J. Volk**, "The Measurement of Photorespiration"; **Dr. C. C. Black**, "Differences in Photorespiration Between and Within Species"; and **Dr. I. Zelitch**, "Biochemical Mechanism of Photorespiration and its Control."

Awards were presented to two graduate students for outstanding contributed papers. The recipients and their paper titles were **Mr. M. L. Salin**, "Variation of Photorespiration with Leaf Age," and **Mr. J. A. Lipe**, "Role of Ethylene in Dehiscence." A breakfast for plant physiologists was held on the morning of February 3, 1971 with **Dr. A. W. Naylor** as the guest speaker on the subject of "The Ph.D. Job Market and the Future of Graduate Education in the Life Sciences."

The following persons were elected to office for 1971-1972: **Dr. P. W. Morgan**, Chairman; **Dr. J. E. Pallas, Jr.**, Vice-Chairman; **Dr. C. C. Black, Jr.**, Secretary-Treasurer; **Dr. J. H. M. Henderson**, Southern Section Executive Committee Member.

It is anticipated that the 1972 meeting will be held at the University of South Alabama, Mobile, Alabama.

Botany Department News — University of North Carolina

Professor J. Edison Adams retired in the spring of 1969 after 34 years of service to our Department. He is keeping busy and happy with his garden, workshop, book revision, and travel. Currently he and **Mrs. Adams** are in Italy. **Professor Donald B. Anderson** retired in the spring of 1970. He and **Mrs. Anderson** have stepped up their previously extensive world travels. **Dr. Tom Odum** resigned as of September 1970 to accept a position at the University of Florida. Another loss was **Dr. Clyde Umphlett**, who resigned to accept a position as Chairman of the Department of Botany at Clemson University, as of September 1970.

In addition to **Dr. R. Malcolm Brown, Jr.**, whose appointment was announced in the last newsletter, three other new members have joined our faculty. **Dr. Brown** came to us from the University of Texas faculty, where he also did his undergraduate and graduate study. He is an ultrastructural cytologist and a physiologist. **Dr. Tom K. Scott**, a plant physiologist specializing in phytohormones, came to us from Oberlin in the fall of 1969 as an associate professor. He received his Ph.D. at Stanford and has held post-doctoral appointments at Princeton, the University of Nottingham, and the Phytotron at Cif-sur-Yvette, France. **Dr. William C. Dickison**, a plant anatomist and morphologist, was added to the faculty in the fall of 1969 to replace

Dr. Adams. Dr. Dickison came from VPI and did his graduate work at Indiana University. Dr. Norton G. Miller, a paleobotanist and bryologist, was added in the fall of 1970 to replace Dr. Umphlett, not as a mycologist but as supervisor of Botany 11. His appointment adds two more fields of specialization. We now have 15 full-time faculty members, 4 part-time members, and 3 emeritus professors.

Edward Barry was on leave to work in the laboratories of Professor J. R. S. Fincham at the University of Leeds during 1969-70.

R. Malcolm Brown, Jr. has spent much time since his arrival designing his phycology and EM laboratories and facilities. Although implementation of his plans has been delayed by difficulties in securing the needed funds, the funds have now been provided and the facilities should be completed by fall. A Hitachi EM, a freeze-etch apparatus, and other essential equipment are already operational and are being used by various faculty and graduate students as well as by Dr. Brown.

Max Hommersand was on leave from June 1, 1969 through February 1, 1970 to study the marine algae of southern California, with headquarters at the Santa Barbara Museum.

Helmut Lieth has been active in IBP. He is participating in the Deciduous Forest Biome studies and is a corresponding member of the IBP Terrestrial Productivity Section. He was the first Director of the Tropical Forest Biome study, but resigned because the position was too time-consuming.

J. Frank McCormick has been on the Editorial Board of *Ecology* and is the new Secretary of the Ecological Society. He has attended numerous international meetings and conferences. He was the Faculty Advisor of the 1970 Carolina Symposium, which dealt with environmental problems. In December 1970 he was appointed by Governor Scott as one of the seven members of the Resource Conservation Committee of the Marine Sciences Council of North Carolina.

John N. Couch, despite the fact that he is retired, is still devoting full time to his research. His current work is on *Coelomomyces*, a fungus parasite of mosquitoes.

Lindsay S. Olive is currently in Africa collecting and studying Protostelia, the subclass of mycetozoa which he discovered. He left March 31 and plans to return about the middle of the summer.

A. E. Radford is a member of the Executive Committee and Advisory Council of the Flora of North America Project. With the *Flora of the Carolinas* pub-

lished, Dr. Radford, Dr. Bell and their coworkers are now actively at work on the *Flora of the Southeast*.

Tom K. Scott was one of the limited number of plant physiologists invited to participate in the Japan-United States Seminar on Plant Growth Substances, held at Michigan State in August 1970.

During the past two years members of the faculty have published 84 papers and 28 abstracts and have given 120 lectures and seminars at various colleges and universities.

The Department suffered a serious loss when Mrs. Margaret Haskell resigned her position as Administrative Secretary in June, 1970, after nine years of service. The resignation was necessitated by the fact that Mr. Haskell, University Personnel Director, accepted a position with the South Carolina Personnel System in Columbia. Her successor, Mrs. Henrietta Brandt, is doing an effective job in this complex and demanding position, although it has taken her most of the year to get well acquainted with the various University policies, procedures, and forms.

In the 1971 ratings of graduate departments by the American Council on Education our ranking among the botany departments of the country improved considerably over our 1966 ranking. As regards quality of graduate faculty we ranked 17 in 1966 and 12 in 1971. As regards the effectiveness of the graduate program we ranked 16 in 1966 and 13 in 1971. If there is another rating we expect to rank still higher, since the ratings were made before we added our last four new faculty members.

C. Ritchie Bell, Director of the North Carolina Botanical Garden, has continued its development despite the lack of adequate finances. An experimental lake has been constructed, more experimental plots have been developed, and plantings and nature trails have been extended. In cooperation with the University Extension Division two non-credit short courses for the public were offered by the Garden during the spring semester: *Winter Botany* and *Spring Wild Flowers*. There were over 55 students in each course and many more had to be turned away. The students were unusually enthusiastic and appreciative of the courses, which were taught by Dr. Bell and Lytton Musselman, a botany graduate student.

However, substantial development of the Garden and its public programs will require much more adequate financing. The Botanical Garden Foundation has provided some badly needed funds, but not of the magnitude required. Our Department has been able to use only a minor part of its budget for Garden operations, and the State has never appropriated one cent specifically for operation of the Garden although budget re-

quests have been submitted each biennium. Currently, members of the Foundation and others are attempting to convince the Legislature of the importance of an appropriation, and hopefully one will finally be made.

The University Herbarium, under the direction of **A. E. Radford** with the assistance of **Curator Stephen Leonard**, continues to grow and now contains over 380,000 mounted specimens and 39,000 unmounted ones. This makes it the largest herbarium in the South and one of the larger ones in the country. The algal collections are being enlarged greatly through the efforts of **Max Hommersand** and his graduate students.

The Department has continued to participate in NSF-financed educational programs. Summer short courses for college teachers have been conducted in Mycology in 1969 under the direction of **Lindsay S. Olive**, and in Ecology in 1970 with **J. Frank McCormick** as Director. We did not apply for one for 1971, and probably will not apply for 1972. Summer research participation programs for college teachers under the direction of **Victor A. Greulich** were offered in 1969 and 1971, no proposal being submitted for 1970. Summer research participation programs for undergraduates directed by **C. Ritchie Bell** have been conducted each summer, but the proposal for 1971 was not granted. The Department has continued participation in the summer courses for superior high school students, with **A. Domnas** as the instructor in 1970 and 1971, and in the Academic Year and Summer Institutes for high school biology teachers. NSF has discontinued the summer research participation programs and did not grant us an AYI for 1970-71.

The Department is participating in a Graduate Curriculum in Ecology which has been set up under the direction of **Alan Stiven** of the Department of Zoology. The Curriculum will offer degrees in Ecology, although ecology students may still take their degrees in Botany, Zoology, or Environmental Sciences if they prefer. **J. Frank McCormick** has worked out an undergraduate Curriculum in Ecology, but this has not yet received final approval.

During the past several years our number of majors has stabilized at about 20 undergraduates and 50 graduate students. Prospects are for about the same numbers next year, although the number of fellowships and assistantships available to us has declined and some 15 graduate students will receive no financial support. Establishment of an Undergraduate Biology Curriculum, with **Tom K. Scott** as Chairman, and including a new year-long General Biology course has so far not resulted in an appreciable decline in our undergraduate majors or our general botany enrollment. This year we have introduced a new non-laboratory introductory course for non-majors (Botany 10) and it has attracted about

100 students each semester. The Department is participating in the new Marine Sciences Curriculum, which is being directed by **Edward Kuenzler** of Environmental Sciences and our Department.

R. Malcolm Brown, Jr. has been serving as our Seminar Chairman for a second year and again assembled an outstanding group of speakers from Germany, Canada, and various U.S. universities, 13 of our seminar speakers being from outside of North Carolina. Next year we will have to rely on local talent, since there will no longer be any lapsed faculty salary funds from which to pay honoraria and travel expenses for visitors from a distance.

Graduate students who are expected to complete the requirements for their Ph.D. degrees by September 1971 are **Carol Aregood** (mycology, Hommersand), **John Bozeman** (taxonomy, Radford), **Philip Crutchfield** (taxonomy, Radford), **Gregory Erdos** (mycology, Olive), **John Ewel** (ecology, Odum), **Neil Grant** (algal physiology, Hommersand), **Thomas McInnis** (biochemistry, Domnas), **Donald McLeod** (taxonomy, Radford), **Kenneth Meyer** (ecology, McCormick), **Chester Michalski** (biochemistry, Domnas), **John Stevenson** (taxonomy, Bell), **Anna Mueller** (taxonomy, Bell), and **Dennis Whigham** (ecology, Lieth). Students who received their Ph.D. degrees in 1970-71 are **Philip Baker** (taxonomy, Bell), **John Clausz** (mycology, Umphlett), **Donald Culwell** (taxonomy, Radford), **Ronald Dillon** (ecology McCormick), **Donald Drapalik** (taxonomy, Bell), **Wallace Martin** (mycology, Umphlett), **Peter Murphy** (ecology, McCormick), **Scott Nixon** (ecology, Odum), **Michael Sears** (biochemistry, Domnas), **Rebecca Sharitz** (ecology, McCormick), and **Donald Windler** (taxonomy, Bell). Despite the current tight situation as regards openings, most of the individuals in both groups have positions now or for next year. However, some are either still available or interested in considering other positions.

We want more news from our alumni for use in subsequent issues. We would like to keep in as close touch with our alumni as possible, and you no doubt would like to know what your fellow graduate students are now doing. The news we would like to have includes changes of positions, promotions, special assignments and activities, additions to your family, and type of research in progress. If you happen to have interesting news about other alumni of the Department send it along too.

Edmund Berkeley (Ph.D. '51) and **Dorothy Berkeley** are continuing their research in the history of botany. Their latest book published by the University Press is *Dr. Garden of Charles Town*. Dr. Berkeley is at Lynchburg College.

In addition to **Clyde Umphlett** (Ph.D. '61), who is now Chairman of the Department of Botany at Clemson University, two of our other alumni are members of the Department: **Ralph Ashworth** (Ph.D. '60) and **Ronald Dillon** (Ph.D. '71).

Rex Baird (Ph.D. '68) is still at the University of Virginia at Wise, Va. **Peter Bostick** (Ph.D. '66) is at Emory University. His wife, Linda, received an M.A. here in 1966. **Sandra Bowden** (Ph.D. '68) is now in the Biology Department at Agnes Scott College.

John Boole (Ph.D. '55) is still at Georgia Southern College but has been promoted to a position as Dean. **Donald Drapalik** (Ph.D. '70) is also at Georgia Southern, as is **John Bozeman** who is here this year completing the work for his Ph.D.

Ted Bradley (Ph.D. '68) is at George Mason College in Fairfax County, Va. He now has a luxuriant beard. **Ross Clark** (Ph.D. '69) is teaching at the University of South Carolina at Spartanburg. Ross has also grown a beard. **John Clausz** (Ph.D. '69) is at St. Andrews College in Laurinburg, N.C.

John Burk (Ph.D. '61) is still at Smith College, where he is Chairman of the Department. Despite his northern location he continues to attend the ASB meetings.

Fairman Cumming (M.A. '69) is doing graduate work toward the Ph.D. at the University of Georgia.

Phil Baker (Ph.D. '70) moved from Pomona College, where he had been teaching for a number of years, to Long Beach State College, California.

Graham Davis (Ph.D. '56) is Chairman of the Department of Biology at East Carolina University. **Donald Jeffreys** (Ph.D. '63) is also in the department as is **Charles Bland** (Ph.D. '69). Charles has a well-equipped EM facility and is actively engaged in ultrastructural research.

Bruce Dayton (Ph.D. '68) is at New York State University at Oneonta. **James Duke** (Ph.D. '59) is with the Batelle Memorial Institute in Columbus, Ohio and has done extensive research for them in Panama. Mrs. Duke was **Peggy-Ann Kessler** (M.A. '56).

Joan Gibson (M.A. '69) has a position at the Smithsonian Institution in Washington. She is in the National Herbarium.

John Haesloop (Ph.D. '60) is still at Pfeiffer College. He has purchased a vacation retreat in the Virginia mountains. He is Treasurer of the N.C. Academy of

Science and is doing an unusually effective job of collecting dues.

John Herr (Ph.D. '57) is still at the University of South Carolina. During the summer of 1969 he taught plant morphology in our Summer Session. **James Horton** (Ph.D. '61) is Chairman of the Department of Biology at Western Carolina University.

Maeburn Huncycutt (Ph.D. '55) is still at the University of Mississippi, but has been promoted from Chairman of the Department of Botany to Dean of the Graduate School.

Fred James (Ph.D. '69), formerly at Westmar College in LeMars, Iowa, has accepted a position at Presbyterian College, Due West, S.C.

Won Kim (Ph.D. '61) has been at the Research Laboratory of the Canadian Department of Agriculture for several years. He is carrying on an active research program and has sent us numerous reprints.

Our three Washington officials are still in the positions they have held for many years. **Robert Leisner** (Ph.D. '58) is with AIBS, **Bert O'Connell** (Ph.D. '55) is at NSF, and **Bill Ziegler** (Ph.D. '48) is with the AEC.

Rick Leonard (Ph.D. '69) is at the University of Alabama at Huntsville. **Harriet Lipscomb** (Ph.D. '68) is at the Georgia State College for Women. **Pauline Longest** (M.A. '47) and **Phil Crutchfield** are both at Methodist College in Fayetteville.

Ariel Lugo (Ph.D. '69) is at the University of Florida, along with **Tom Mullins** (Ph.D. '59) who has been there for many years, and **Lee Shanor** (Ph.D. '37) who is Chairman of the Department of Botany. Lee is president-elect of ASB.

Tom Marsho (Ph.D. '68) spent two years as a post-doctoral fellow at the Research Institute for Advanced Studies in Relay, Md. and is now on the faculty at Florida Technological University in Orlando.

Peter Murphy (Ph.D. '70) is on the faculty at Michigan State University. **Scott Nixon**, also a 1970 ecology Ph.D. is at the University of Rhode Island. **Rebecca Sharitz**, our third 1970 ecology Ph.D. is at Saginaw Valley College, Michigan. Becky will be here this summer as a research associate with J. Frank McCormick.

Charles E. Miller (Ph.D. '57) is now Chairman of the Department of Botany at Ohio University. **Gary Miller** (Ph.D. '68) is on the faculty at Eisenhower College, Seneca Falls, N.Y.

Wallace Martin (Ph.D. '70) is a research associate with John N. Couch this year and next. He is in the market for a mycology teaching position beginning in September 1972.

Sabina Mueller (Ph.D. '68) has married and is now Mrs. Sabina Mueller Sulgrove. She is presently residing in Kettering, Ohio. Peter Nielsen (Ph.D. '65) is at the New York State University College in Plattsburgh. Mrs. Nielsen was Ann Whitlock (M.A. '60). Daniel Plyler (Ph.D. '64) is still at the University of North Carolina at Wilmington.

Elmer Pritchard (Ph.D. '54) who was at Stetson University for many years died on April 20, 1970.

George Ramseur (Ph.D. '58) is still at the University of the South. He taught ecology for us in our 1970 Summer Session.

Michael Sears (Ph.D. '70) has been a research associate at Duke University this year. He is in the market for a position in biochemistry.

Paul Szanislo (Ph.D. '67) is in the microbiology department at the University of Texas.

Among our 1970 crop of Ph.D. graduates two have not been mentioned previously. Donald Culwell is at Arkansas State College in Conway. Donald Windler is at Towson State College, Maryland.



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The ASB

BULLETIN

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January 1972



FEB 23 1972

Adult Chironomid in style of the Haida — by Selwyn Roback (see page 2)

*The Official Quarterly Publication of
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CONTENTS

Association Affairs	2
About the Mobile Meeting	3
Walter Auffenberg to deliver the invitational address on Komodo Dragon	8
Conservation Issues in the Southeast — Where is ASB?	10
Pollution Proportional to Population. — by B. Theodore Cole	14

THE COVER

A characteristic feature of Northwest Indian art is the concept of bilateral representation; splitting or dissecting an animal into halves to show both sides. Mammals are represented by two facing profiles; birds by two profiles back-to-back. Sometimes the component parts are re-arranged and stylized to the point where the animal is unrecognizable. The most common animals used are the bear, beaver, wolf, eagle, hawk, crane, killer whale, frog, and shark. The cover is a wood block print of an adult chironomid in the style of the Haida, executed by Dr. Selwyn Roback of the Academy of Natural Sciences of Philadelphia.

ASSOCIATION AFFAIRS

ASB Committees 1971-1972

Dates in parentheses indicate years appointments terminate.

Research Award Committee

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Chairman: William Mengebier (1972),
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Stuart Bamforth (1973),
 Newcomb College (Tulane)
Robert T. Brumfield (1974),
 Longwood College

(Continued on page 7)



BELLINGRATH GARDENS, near Mobile, Alabama. A view of a portion of the central part of the Gardens.

About the Mobile Meeting

The Association of Southeastern Biologists will hold its 33rd annual meeting April 6-8, 1972, at the Educational Research and Development Center, University of South Alabama, Mobile, Alabama. Registration will be in the Registration Building of the Conference Circle. Ample parking will be provided a short walking distance from the Conference Circle. The Thursday evening program will be in the main hall of the Conference Center and a "social hour" will be

held in the same building immediately following this program. Plant physiology papers will be held on Thursday and Friday and papers in other sections will be held Friday. Some other sections may have Thursday afternoon meetings if warranted by the number of papers to be presented. Business and other special meetings of affiliate groups meeting with ASB and of the Association will be held on Friday, unless other times are requested. The annual banquet and presentation

of awards, followed by the retiring President's address will be held in the main hall of the Conference Center.

General Information

First seen by Spanish explorers over four and a half centuries ago, the Mobile Bay area grew and developed under the rule of European nations struggling for colonial power in the New World, hosted the prosperous and charming era of the Cotton Kingdom, and ultimately developed into a cosmopolitan area with a bustling world seaport. Mobile itself served under three European flags — Spanish, French, and English — and later the flags of the State of Alabama, the Confederacy, and the United States flew over the city. Thus, Mobile has come to be known as the City of Six Flags.

Mobile's main industries now include ship-building and ship repair, timber, naval stores, chemicals, steel, cement, paper products, aluminum, rayon fiber, oil refining, and others.

As an educational center, Mobile has four institutions of higher learning: University of South Alabama, Spring Hill College, Mobile College, and Mobile State Junior College.

The University of South Alabama was chartered in 1963 and received its first students in June, 1964. The main campus is located in the western section of Mobile, approximately 10 miles from the downtown business district. The Educational Research and Development Center of the University, site of the 1972 ASB meetings is located on a portion of the former Brookley Air Force Base near the downtown section of the city, on Mobile Bay. The University comprises a College of Arts and Sciences, College of Business and Management Studies, College of Education, and Division of Engineering. Current enrollment is approximately 5,500. The newly created College of Medicine will receive its first students in September, 1972.

Mobile weather in early April is usually mild, and showers may be anticipated.

Travel to Mobile

The city is served by Eastern, National and Southern Airlines and by Greyhound and Trail-

ways Bus Lines. Major highways from the east are U.S. 90 and 98; from the west U.S. 90, 98, and I-10; and from the North by U.S. 31, 43, 45, and I-65. Entrance to Mobile from the east and northeast is via Bankhead Tunnel which has a \$.25 toll. Limousine service is available from the Airport to all motels. Private planes may land at the Mobile Aerospace Airport (Brookley Field) which is adjacent to the Educational Research and Development Center. Information on private plane facilities may be obtained from South Alabama General Aviation, Building 901, Mobile Aerospace Airport, Mobile, Alabama 36605.

Points of Interest

Participants in these meetings are urged to bring their families to enjoy the outstanding attractions of Mobile during the azalea season. Some of the things you may want to do are:

Visit old homes in DeTorty Square and Church Street East

Tour the Alabama State Dock and International Trade Center

See Oakleigh and other historic homes

Board the USS Alabama and Submarine USS Drum

Visit Bellingrath Gardens

Visit the shrimp fleets at Bayou la Batre and Coden

Explore Fort Gaines, ancient shell mound and the Audubon Sanctuary on Dauphin Island
Drive leisurely along the Azalea Trail (The azaleas should be in peak bloom)

Paper Sessions

Meeting rooms of the Conference Circle

Exhibits

Conference Circle Exhibit Hall

1:00 p.m. — 10:00 p.m. Thursday

8:00 a.m. — 5:30 p.m. Friday

Other Scheduled Events

Breakfasts and luncheons may be scheduled at local restaurants if reserved in advance.

Housing

Accommodations for 160 members are available at the Educational Research and Development Center. These accommodations are arranged in suites of two rooms which share a bath and lounge area. Each room is designed for double occupancy and is air-conditioned. The charge for these accommodations is \$8.00 per night per room. Linen and maid service for cleaning is provided, but occupants will have to make their own bed. In addition to these quarters, students may be housed in dormitories adjacent to the Cafeteria and within walking distance of the conference Center. The charge for dormitory rooms will be \$2.00 per night per person. The dormitories are not air-conditioned;

however, this should not be an inconvenience in early April. Dormitory rooms are available only to students. Linen is also provided in the dormitories. Reservations for rooms at the ERDC may be made by writing: Housing Office, Building 254, Educational Research and Development Center, Mobile, Alabama 36615. Payment for one night's lodging must accompany the reservation request. Make checks payable to University of South Alabama. It will be necessary for persons making reservations for on-campus housing to indicate whether occupants are male or female.

Off-campus housing is being handled by the Mobile Area Chamber of Commerce. The motels and hotels listed below have reserved rooms



LIFE SCIENCES BUILDING, UNIVERSITY OF SOUTH ALABAMA

for this meeting until March 20, 1972. *Since the meeting will be held during the peak of Mobile's annual Azalea Festival, it is strongly recommended that reservations be made early.* All hotels and motels have been advised that reservations for the April meeting will be made through the Chamber of Commerce. Please follow this procedure and let the hotel or motel know, when you check in, that you are with

the ASB meeting.

Fill out the attached form as soon as possible and mail to:

Miss Judi Carter
Mobile Area Chamber of Commerce
Post Office Box 2187
Mobile, Alabama 36601

Rates listed do not include sales tax of 7%.

Via I-10 and Broad Street

		min. sgl.	min. dbl.	rms res	
Admiral Semmes Hotel	4.0 miles	\$10.50	\$15.00	250	1-3 rm suite
Admiral Semmes Motor Hotel	4.0 miles	13.00	17.00		1-2 rm suite
Battle House Hotel	4.3 miles	11.00	14.00	50	1 suite
Holiday Inn Downtown	3.8 miles	13.00	18.00	20	
Malaga Inn	3.8 miles	14.00	16.00	15	
Mobile Travelodge	4.4 miles	10.50	13.50	70	

Via Government Street and Michigan Avenue

Albert Pick Motel	4.2 miles	12.00	16.00	25	
Rodeway Inn-Government St.	4.2 miles	11.00	15.00	100	
Rodeway Inn-Michigan Avenue	1.9 miles	12.50	16.50	50	2 parlors
Town House Motel	4.4 miles	11.00	15.00	50	

ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

Name _____

Address _____

City, State, ZIP Code _____

Arrival Date _____ Time _____ a.m.

_____ p.m.

Departure Date _____

Motel Choice: _____ Accommodations:

First _____ 1 person, 1 bed _____

Second _____ 2 persons, 1 bed _____

Third _____ 2 persons, 2 beds _____

If sharing a room with another person, please give his name:

Dining Facilities

Meals will be available in the ERDC cafeteria, a short walk from the Conference Circle. Numerous restaurants are located a short drive from the Conference Circle. Many of the restaurants serve outstanding seafood specialties.

Beverages may be purchased at State Liquor Stores or by the drink at numerous lounges.

Field Trips

Local trips are being planned to Bellingrath

Gardens, featuring both the formal gardens and natural area, and to the Mobile River delta area. A fee will be charged for the Bellingrath trip.

Placement Service

Potential employers and employees are urged to register with the Placement Service located adjacent to the registration area. Interview schedules may be arranged in private rooms.

Local Arrangements Committee

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Robert A. Woodmansee

American Society of Ichthyologists and Herpetologists, Southeastern Section Representative: *Neil H. Douglas*,
Northeast Louisiana University

Association of Southeastern Parasitologists Representative: *Raymond L. Kisner*, Troy State University

American Society of Plant Physiology, Southern Section Representative: *Clanton C. Black*, University of Georgia

Beta Beta Beta Representative: *John H. Mullahy*, S. J., Loyola University

Travel Award Committee

Chairman: Stephen Gittleson (1972),
University of Kentucky
Clarence Styron (1973),
St. Andrews College
Beryl C. Franklin (1974),
Northeast Louisiana State
University

Place of Meeting Committee

Chairman: Joseph Fitzpatrick, Jr. (1971),
Randolph-Macon Woman's
College
Dolores Dundee (1972),
Louisiana State University
Rudolph Prins (1973),
Western Kentucky University
Gerald W. Esch (1974),
Wake Forest University

Resolutions Committee

Chairman: John M. Carpenter (Retiring Post-
President: University of Ken-
tucky)
James C. Wilkes (State Corres-
pondent: Troy State University)
Arthur R. Garrett (Host Institution
Representative: University of
South Alabama)
Joseph F. Fitzpatrick, Jr. (Execu-
tive Committee Representative:
Randolph-Macon Woman's Col-
lege)

Auditing Committee (1971-72)

Chairman: C. Ritchie Bell, University of
North Carolina
John N. Couch, University of
North Carolina
Albert E. Radford, University of
North Carolina

(Continued on page 9)



Walter Auffenberg to Deliver the Invitational Address on Komodo Dragon

The Invitational Address will be given this year on Thursday evening, April 6 by Dr. Walter Auffenberg, Curator of Herpetology and Chairman of the Department of Natural Sciences of the Florida State Museum, and Professor of Zoology at the University of Florida. His lecture is entitled "Predator Dynamics of the Komodo Dragon", an illustrated presentation summarizing observations on behavior and ecology of this, the largest and oldest living lizard, some reaching a length of 10 feet and weighing 250 pounds. For almost a year Dr. Auffenberg, his wife, and their three sons lived on the island of Komodo in Indonesia in order that they could make a comprehensive study of the behavior and ecology of these large land reptiles.

Dr. Auffenberg is a native of Michigan. He received his B.S. degree from Stetson University and both the M.S. and Ph.D. degrees from the

University of Florida. He studied also at Brandeis University and at Harvard University. He has served as Associate Curator, Charleston Museum, as USIS consultant in India, and as an AID consultant to the Center for Latin American Studies in Panama. His research on behavior, ecology, and systematics of reptiles and amphibia have taken him to many places in addition to India, Indonesia, and Panama. He has worked also in Argentina, Mexico, Israel, Austria, Great Britain, and many islands of both the Greater and Lesser Antilles.

Dr. Auffenberg is a fellow of the American Association for the Advancement of Science and of the Herpetologists League. He has served on the Board of Governors of the American Society of Herpetologists and Ichthyologists and on the Steering Committee of the Biological Sciences Curriculum Study. From July 1959, through

August 1963, Dr. Auffenberg was Associate Director, Biological Sciences Curriculum Study. He is a member of the Society for Vertebrate Paleontology, Society of Naturalists, and the Society of Zoologists. His studies have been supported by the National Science Foundation, the American Philosophical Society, Sigma Xi, the University of Colorado Museum, the Research Fund of the American Society of Ichthyologists

and Herpetologists, and by the University of Florida.

Dr. Auffenberg is the author of more than 50 articles published in scientific journals reporting on his studies of large reptiles, both fossil and living. Members of the Association can look forward to an inspiring account of this study of the Komodo dragon, a living relic of 60 million years ago.

Nominating Committee (1971-72)

Chairman: Robert Short, Florida State University
Harry J. Bennett, Louisiana State University
William D. Burbanck, Emory University

Local Arrangements and Program Committees

University of South Alabama (1972)
John Rawls—Chairman
Arthur R. Garrett
Western Kentucky University (1973)
Gary Dillard—Chairman
Rudolph Prins

Conservation Committee (1971-72)

Chairman: E. C. Clebsch (1972),
University of Tennessee
Arthur W. Cooper (1973),
North Carolina State University
Thomas C. Barr, Jr. (1974),
University of Kentucky

Special Ad Hoc Committees

Archivist

Madeline P. Burbanck, Emory University

Parliamentarian

Perry C. Holt, Virginia Polytechnic Institute and State University

AAAS Representative

John D. Withers (1973), Clark College
B. T. Cole (1971),
University of South Carolina

AIBS Representative

Franklin F. Flint (1973),
Randolph-Macon Woman's College

Annual Voting Procedures

Perry C. Holt, Virginia Polytechnic Institute and State University

Past President's Council to Review

ASB Purposes

C. W. Hart, Jr., Academy of Natural Sciences of Philadelphia

Standards Committee

John D. Withers, Chairman, Clark College
David J. Cotter, Georgia College
Frank Flint, Randolph-Macon Woman's College

Conservation Issues in the Southeast -- Where is ASB?

Concern over conservation issues on the part of ASB as an organization dates back to about 1966, as evidenced by evening speakers at programs given at the annual meetings. Commentary and action of the organization did not really begin until 1967 with the appointment by then President Dr. Harold Humm of an *ad hoc* Conservation Committee. The charge to the new committee (ASB Bull. Vol. 14, p. 70) was broad and strongly empowering.

In order that the Association of Southeastern Biologists may have an appropriate and effective means of expressing the general feeling of the membership concerning conservation problems, a five-member committee has been appointed.

It is the duty of the new Conservation Committee to evaluate such problems, especially in the southeastern states; to express their opinion, to recommend a course of action, or to oppose an imminent action that would damage or destroy a natural area which it appears to be in the public interest to preserve. The committee is authorized to make public resolutions of their own at any time. With conservation problems of major importance on which action is not required promptly, the committee may bring the matter before the membership at the annual meeting and perhaps present a resolution for possible adoption by the ASB as a whole.

The committee will also serve as a means of communication between the Association and various conservation agencies who will thus be able to determine the viewpoint of ASB concerning current problems and, in many cases, gain the Association's support in what they are trying to do. Conversely,

the Association will have an agency authorized to convey the opinion of the membership on conservation problems and proposals and to communicate with appropriate government or private agencies. The new committee will provide a new and more effective means of promoting the restoration or preservation of natural areas or resources in the southeastern states than ever before and, hopefully, before it is too late to act.

The work of the committee from its inception until its conversion to a standing committee in 1971 has been varied, but has unfortunately involved relatively few members of the Association. It has helped draft State and National legislation, has offered expert testimony at Congressional hearings, at state hearings on legislation and in legislative committee work, and has offered advice to several members who were active in their own way in conservation matters in the Southeast. The committee has often called upon the membership to offer testimony at public hearings on wilderness areas, and has occasionally acted as a referral service in the seeking out of expert witnesses for law suits.

Although these enumerated activities are appropriate and worthy of continuation, there are better ways of utilizing the skills of the membership of the Association. One of those is for the Association to engage itself in a compilation of distribution maps and habitat descriptions of rare or endangered species in the Southeast. A second is that we embark upon

an inventory of quality natural areas in the Southeast, and that we make that inventory available to appropriate government agencies and foundations which might help in the preservation of the superb natural areas.

Individual members of the Association have repeatedly asserted themselves in environmental issues as private citizens, but have often failed to display any identification with ASB. We have not been represented on many occasions when we should have been. The reasons are the common ones of over-commitment, ignorance, apathy, or shortage of time and travel support.

Even with all the short-comings and faults listed above, the Association has been represented on many kinds of issues and in a variety of ways. The first official action by the Association came through a resolution in 1968 to endorse the concept of a "Circle-the-Smokies" drive in eastern Tennessee and western North Carolina. The issues of further roads and other developments in and around Great Smoky Mountains National Park and the designation of units in the National Wilderness Preservation System in the park remain alive even now. We have attempted to stay abreast of the issues and to comment when and where appropriate. The same "Circle-the-Smokies" highway net was endorsed by the National Park Service as its "Transportation Concepts, Great Smoky Mountains National Park, North Carolina-Tennessee," released in May, 1971.

The complicated and controversial issue of the partly completed road from Robbinsville, N.C., to Tellico Plains, Tenn., has many biological implications. Various aspects of the issue have been examined by members of ASB in concert with the Wilderness Society, Sierra Club, and a review team organized by the U.S. Forest Service. The road would traverse either a portion of the Joyce Kilmer Memorial Forest or the drainage of Slickrock Creek. Together these two landscape units would possibly qualify as a unit of the National Wilderness Preservation System under the Wilderness Act of 1964. The issue remains a hot one and deserves the services of knowledgeable biologists. If you are familiar with the area, contact your committee.

Further commentary on the national parks was offered on wilderness designation in Cumberland Gap National Historical Park, Kentucky-Virginia-Tennessee, Everglades National Park, and Mammoth Cave National Park. Some of the broad ecological and more particular biological consequences of the Miami jetport for Everglades National Park were pointed out to state and federal officials. One member of the committee functioned on the master-plan team for Mammoth Cave National Park.

The Association, acting as a body at the time of its annual meetings, has also endorsed other resolutions concerning conservation issues. One called for the establishment of a national park to include a portion of the Big South Fork of the Cumberland River in Kentucky and in Tennessee and its Clear Fork and New River stems in Tennessee. Another endorsed Earth Day in 1970 and the other resolution passed by the body assembled decried the practice of clear-cutting of large acreage blocks in Appalachian National Forests.

A number of issues of national importance or having to do with regional or local problems outside the ASB region have been commented upon through the years by the committee. These have included a request to Secretary of State Rogers that he not proceed with the clearing and defoliation of a strip twenty feet wide and three thousand miles long on the border between the U.S. and Canada, including the Alaska-Canadian border. The vegetational control was to be and has been by herbicides. We endorsed the National Environmental Policy Act legislation which also established the Council on Environmental Quality. We vigorously opposed the subsequently defeated National Timber Supply Act of 1970. We commented profusely on the trans-Alaska pipeline system, and the chairman of your committee traveled to Washington under the sponsorship of the Wilderness Society to appear before the Senate Interior Committee to offer testimony on the issue. We asked the Pesticide Regulation Division of the U.S. Department of Agriculture to consider our request to cancel DDT as a commodity on the American market. We suggested to several Congressmen that an

increase in the appropriation for the Land and Water Conservation Fund was in order. We offered written testimony for the public hearing on a proposed U.S. Army Corps of Engineers dam in a natural area in a state park at Warley Flats, California. We informed some local congressmen of a proposed U.S. Army Corps of Engineers dam on Lusk Creek, Illinois, and were gratified to have one of those congressmen follow through with requests from the Army Corps of Engineers for additional information. We commented to congressmen on the potential environmental consequences of the supersonic transport.

It has been suggested by some members of the Association that the committee is spending too much of its effort on issues which are outside the region and do not impinge directly on it. It is a truism that conservation organizations value and need help from outside their local regions. What are your thoughts? Communicate them to us.

Each state which receives monies from the federal Land and Water Conservation Fund has to prepare a comprehensive outdoor recreation plan every five years as part of its requesting document. By knowing this and by contacting the planning agency, your committee could comment on biological considerations for the one in Tennessee. Is a similar opportunity available to you in your state?

Two states in the ASB region, Florida and Tennessee, now have legislation which provides for the preservation of wilderness or natural areas by the state. Does your state? Would you help draft such legislation? Will you help implement the legislation and define the characteristics of proposed natural areas to be protected by the legislation?

Bowaters Southern Corporation has large land holdings in Tennessee and Alabama on which it produces pulpwood. It has recently instituted a program of pocket wilderness areas, of which it has set aside three. The foot trail in one of them has been designated by the U.S. Department of Interior as a National Scenic Trail under the National Trails Act of 1970. Bowaters seems to be the only company engaged in such activity. We were able to help them draw

up guidelines. Are there similar companies in your state which might be persuaded to do similar things?

The National Wild and Scenic Rivers Act set aside several rivers around the country to be preserved in a free-flowing wild, scenic, or pastoral condition. The Obed River of Tennessee was included in the "study" category under the bill. It is now being studied by a team of people from the federal and state governments, and hopefully will eventually be preserved. In the meantime it is severely threatened by recreational developments and by strip mining for coal. Many of the rivers in the ASB region would qualify under the national bill and could be placed there with the endorsement of the local governor. Tennessee was the first state in the nation to pass state legislation protecting wild and scenic and pastoral rivers. Perhaps your state could follow suit.

The national demands for navigable streams, slack water recreation, power development, flood control, and others are always threatening our free-flowing rivers. Stream channelization is an additional threat endorsed by the Soil Conservation Service, U.S. Army Corps of Engineers, and other agencies of the federal government. The Little Tennessee, the Duck, the Obion, the Forked Deer, and the Big South Fork of the Cumberland River either have been or are threatened with severe changes in the state of Tennessee alone. The long dreamed of canal connecting the Tennessee and Tombigbee River systems has had large sums of money appropriated for it, and has been dedicated as a project. The biological consequences of the project are profound—and profoundly questionable. The classic case of the Oklawaha in Florida, including a Presidential stop order, is not dead. At the time of this writing, the Florida Canal Authority is attempting to declare unconstitutional President Nixon's stop order of many months ago. Many members of ASB were involved in the writing of affidavits which led to the Presidential work-stop order, but through no effort of your conservation committee.

Where else has your conservation committee been inactive and unconcerned when it might

have been active and concerned? We know of a few examples, and for every one that we know of there are probably ten more. Off-shore oil exploration in the Gulf of Mexico is a big one that we have had no voice in. The valiant fight on the part of citizens in coastal South Carolina in warding off industrial development by a foreign chemical manufacturer is another. Legislation protecting coastal wet lands in North Carolina and in Georgia are two more. A valiant effort to route an interstate highway around Overton Park in Memphis is still being fought in the courts. Your committee was not officially involved at any point. We do not seek to be reminded of our historical omissions, but diligently seek help in finding current issues in which we may still be effective.

The National Environmental Protection Act of 1969 requires that all federal governmental agencies proposing legislation or planning to undertake an action "significantly affecting the quality of the human environment" file an impact statement with the Council on Environmental Quality. As of June 30, 1971, statements on 1,380 actions had been received by the Council. The public has a voice, and we and you are part of it.

The addition of a standing committee or the change from *ad hoc* to "standing" status requires a change in the by-laws. You, the membership, recognized that conservation should be added to auditing, nominating, local arrangements and program, and resolutions as one of ASB's standing committees by changing our by-laws. *If you meant it, show it. If you are concerned over conservation matters and are already involved,*

we commend it, but let us know it. If you care and are talking only to those who have similar concerns, your talk may be ineffective. Let us know that you care and what you care about. It is as important that your committee know the manpower resources of ASB as it is that they know the biological problems to which we should be addressing ourselves.

At its October 1971 meeting, the Executive Committee of ASB reiterated a new charge to the committee, one which had been passed by the membership in April, 1971. The charge and an additional request from the Executive Committee follow:

The Conservation Committee shall accumulate facts with reference to environmental problems, shall disseminate such information to the membership at its (the Committee's) discretion, and may bring resolutions concerning matters of significance to the attention of the Executive Committee, through the Resolutions Committee, for presentation to the membership.

The Conservation Committee shall also compile a list of appropriate experts who are conversant with various aspects of the environment and shall transmit this together with pertinent information on immediate and potential environmental problems to the Executive Committee — which, through the President, shall communicate this upon request to appropriate governmental officials.

If you (1) have expertise on some aspect of environment or (2) know of immediate or potential environmental problems, whether they be local, regional, or national, please help your committee carry out the new mandate of the Executive Committee. Care enough to get involved! Care enough to contact your Conservation Committee!

Conservation Committee

EDWARD E. C. CLEBSCH,
Chairman (1972)

ARTHUR COOPER (1973)

THOMAS BARR (1974)

B. THEODORE COLE
Professor and Head, Biology
University of South Carolina
Columbia, South Carolina

Pollution

Proportional To

Population

Although the writings of Hippocrates, Aristotle and other philosophers of the Greek period contain information clearly ecological in nature, the Greeks did not have a word for it. Ernst Haeckel, a German biologist first proposed the word "ecology," about 100 years ago in 1869. Modern ecology is very little younger, dating from 1900. The word is derived from the Greek OIKOS meaning house or "place to live," literally, the study of organisms at home!

It has been said that natural history becomes ecology when how many (quantitative) as well as qualitative (what kinds) are considered. One crow/100 acres would cause a farmer no concern, but 1,000 crows/10 acres would be something else!

Biology has been depicted as a layer cake with basic layers representing disciplines such as morphology, physiology, genetics, ecology and so on. The cake "slices" might be labelled, Taxonomic divisions such as Bacteriology, Ornithology, Mycology, Entomology and so on.

The property of "life," nebulous, ill-defined yet real to all living things, resides in protoplasm. It is redundant to speak of living protoplasm since dead protoplasm is inanimate. The uniqueness of living things lies in functional organization at all levels of complexity. One may isolate the ultracellular fractions of cells and they may demonstrate measurable characteristics of life: (i.e. enzyme activity, capacity to replicate molecules) but until they are appropriately organized within cells, they do not *in toto* possess the capacity "to live." Biologists think in terms of functional organization at many levels of complexity. Collections of cell types (similar and dissimilar) are organized into tissues, and various tissues in turn compose organs. Organs, in turn, interact to form organ systems which in turn are integrated, contributing effective roles to the well being of a complete organism. Organisms, in turn form populations, different populations form communities, which collectively and in turn, constitute ecosystems. The planet earth and its component ecosystems make up our biosphere.

Just as *Homo sapiens*, man is many things, physical, emotional, psychological, spiritual, and his structure is such that interacting anatomical forms interact to support the whole, the com-

munity, in an ecological sense, includes all of the populations occupying a given area. The Community and the inanimate environment function together as an ecological system, or Ecosystem. The Biosphere is defined as the portion of our "Mother Earth" in which ecosystems operate. From the standpoint of interdependence, interrelations and survival, there can be no sharp discontinuity anywhere along the line of this spectrum. Each unit is interdependent upon its next lower and next higher component. The individual organism cannot survive long without its population and its constituent organ systems any more than the organ would be able to survive long without its organism or its constituent tissues. Malfunction in any part gives a degree of weakness to the whole. For example a sick population (it too can die) would work to the detriment of a community. Also, the community cannot exist long without the cycling of materials and the flow of energy in the ecosystem. The health of cells and tissues is essential to the normal function of organs and systems, in turn essential to the well being of the organism in a highly competitive society.

The biosphere is a thin slice of life, wide as the world but thin as an onion skin. This envelope of life containing air, water and soil measures less than 8 miles deep and makes up 1/1000 of the planet's diameter. Some creatures inhabit the extremes of the biosphere which indicates how adaptive and tough the vital processes of life are.

That life exists at all on this spaceship earth, is a kind of miracle. Earthly organisms can exist within a narrow temperature range of 120 degrees. Temperatures in the known universe range from unimaginable heat in the cores of younger stars to the absolute zero cold of outer space, a range perhaps of 20 million degrees. Life as we know it depends upon a mix of atmospheric elements which is, incredibly exotic. Oxygen, vital though it is, must be mixed in proper proportions with other gasses just to keep the whole business from blowing up. Finally, the upper atmosphere (tenuous as it is) protects the lower biosphere from the full spectrum of energy irradiated by the Sun and thus in a sense "permits" life.

Homeostasis is a biological concept which recognizes the necessity for highly unstable constituent systems in order to provide stability to the whole. Highly stable units have low adaptability. The concept is applied to individual cells, whole organisms, populations or the biosphere.

In a cell, for example, the intracellular organizational activities apropos the property of "Life" in protoplasm, may require a pH (hydrogen ion

content) which varies with time. The range of variation may be important, however, to assure that only those activities commensurate with continued life, persist. A complex solution of ionizable substances allowing for pH change, are locked into protoplasm, along with appropriate buffers, which prevent the change from reaching detrimental proportions. At the organismic level, a circulatory pump, although endowed with a cardiac muscle with an inherent capacity to beat, must be secondarily structured to be sensitive to change, i.e., self-regulated with respect to need for increased or decreased circulation assuring numerous tertiary benefits to the organism. The biological capacity to forget also helps the organism to achieve psychological stability (Homeostasis).

In nature, the population and the larger unit, the biosphere left alone, also achieve stability (homeostasis). Diversity of plants and animals, all interdependent, assures a biological balance (homeostasis), but low productivity. Man requires high productivity and thus loses stability. Even in the exercise or judgment in handling his own *internal* environment, man frequently stresses inherently stable systems and incidentally becomes obese. Blood sugar levels are normally maintained from a mixed diet and optimal caloric intake. Normally then, "X" amounts of endogenous insulin are required to maintain stability (homeostasis) with respect to blood sugar levels. Man may overwhelm the system and temporarily spill sugar in the urine (thus excretion itself contributing a measure of stability). It has been shown that force fed rats can be made permanently diabetic, thus suggesting a kind of overloading to the point of failure, of a simple homeostatic physiologic mechanism.

In the plant world a stand of mixed hardwoods and pine though highly stable is less productive in terms of wood products, than is a stand of 3 to 6 inch trees of a single species growing like grass. The latter, however, is fast growing, more susceptible to a "crash" population decrease from disease, fire or other environmental pressure and thus is unstable.

Pollution, by definition, may be considered a normal biologic activity which itself is part of a precisely defined biological balance or "order of things." It is a part of environmental pressure limiting populations. Man's tendency to pollute is a gross exaggeration of biologic levels and thus is capable of extraordinary environmental pressures.

Although some men have probably thought about, and actually involved themselves in pollution problems, to varying degrees since men first stood too close to a campfire and coughed,

rubbed their eyes, or burned woody materials rich in terpentine-like compounds, recent emphasis and popular concern about pollution has been strongly influenced by Rachel Carson's "The Silent Spring" published in 1962.

This sensitive soul wrote her best known book, "The Sea Around Us" in 1951. Miss Carson with an MA degree from Johns Hopkins, researched the effects of DDT spraying in Canada, accomplished to eliminate the spruce budworm, a program designed to "Save The Forests." Her Chapter, "Rivers of Death," is a classic record of the manner in which man, solving problem A, precipitates, problem B.

Salmon, repeating a biological trek that was age old, moved in from the Atlantic Ocean to the river called Miramichi on the coast of New Brunswick in the summer. Eggs were laid in swift, cold headwaters in autumn, developed within their delicate membranes during the winter, and hatched in the spring of 1954. Within two days of heavy spraying of DDT, dead and dying fish, including many young salmon, were observed. Before spraying, there was an abundance of water life that formed a food source for salmon (caddis fly larvae, stonefly nymphs, worm-like larvae of black flies. These were the first to die.).

In the fall of 1954 a tropical storm played its part in the fortune of Miramichi Salmon. Hurricane Edna and its torrential rains produced freshets which carried streams of fresh water far out to sea and drew in unusual numbers of Salmon. In 1955 the salmon runs were again excellent because man stopped what he was doing and nature intervened to "clean up."

I should like to make two points. Man frequently, perhaps inevitably, pollutes his environment in order, he believes, to gain an advantage from the environment. Although he does not necessarily see the detrimental results of his action, he takes positive steps to pollute for a purpose: (i.e., spray DDT to be rid of the budworm to save the forests). He often weighs the gain heavily and the loss he disregards or weighs lightly. This is not atypical behavior on the part of man, since history is replete with evidence that he has often acted as if the ends justified the means.

That modern man has affected the flora, fauna and even the weather on some areas of the planet, is not questionable. Man-made deserts in Asia and Africa are not uncommon. Near barren land now obscures the fact that Palestine once flowed with "milk and honey," and that the mountains of Greece were once heavily forested. In the early years of environmental destruction, people always had the luxury of

good soil somewhere else. Presumably they were also willing to move!

Scientists disagree on the quantitative effect of pollution on animals, plants and materials, except on relatively narrow, local levels. Some estimates of the cost of soiling and deterioration of property have been made, but the estimates are only a step beyond guesses. In no area of the world is the mean annual level of air pollution high enough to cause continuous, acute, health problems. Emitted pollutants are diluted in the atmosphere and swept away by winds, except during an inversion. An inversion may persist from a few hours to a week. Few are surprised to find correlations with respiratory diseases including lung cancer and emphysema. Qualitative links are of little use. The state of one's health depends on factors both present and past, such as inherited characteristics, personal habits (smoking, drinking, exercise), general physical condition, diet (including pollutants ingested with food, drugs including alcohol and caffeine ingested) living conditions, urban and occupational air pollution and water pollution.

The possibility of a buildup of CO₂ levels sufficient to influence climatic changes in this century is remote. Atmospheric oxygen remains practically constant at 20.946%. It is estimated that if all the world's recoverable fuels were burned, the oxygen level would be reduced only to 20.800%. DDT is not expected to have a significant effect on the ability of marine algae to convert CO₂ to O₂. DDT residues in mackerel and other plankton feeders, is another and more serious problem. Up to 1.5 million tons of oil are introduced into Oceanic waters each year through drilling, shipping and accidents. Another 3 to 4.5 million tons disposed of on land, may eventually reach oceanic waters.

War has played its part in pollution; 2,800 merchant vessels and who knows what their cargo, 175 allied warships and 779 u-boats loaded with diesel fuel, rest on the bottom of the Atlantic. 4,750 B-17's were scattered over Europe in bits and pieces. At Pearl Harbor alone 18 ships were sunk in an area of about 10,000 acres.

Pollution problems are not confined to the Free World. Russians, who should have a system that could defeat or accomplish anything, have immense pollution problems also. Soviet Geographer S. Vendrov complains that although the USSR has 16% of the World's land mass they have only 11% of the fresh water and 88% of that is located where only one-quarter of the citizenry live. Waters of the highly industrialized Central Russia, Urals and Central Asia, are critically polluted. Air pollution in the form of

fertilizers blown off land in the Krasnodar region by dust storms, carried into the sea and caused fish kills on the Kuban river.

The International Working Party of Waterworks in the Rhine Catchment area, representing 50 waterworks in Switzerland, West Germany and Holland, says the Rhine is being contaminated to such an extent that unless radical measures are taken, it will not be able to keep up its remarkable powers of self-purification. The resultant water will not be fit to feed to livestock even with waterworks better equipped than those in service today.

Our discussion of Homeostasis would allow us to predict that an environmental situation should be able to withstand considerable input of "pollutants." It may finally, however, reach a point analogous to that of a solution containing a given chemical compound. When a milligram of additional compound is added, there precipitates out of the solution, a measurable mass in solid form. When an environment is "on the brink," relatively small addition of pollutants results in large scale mortality of life therein. Such is the case at the present time with Lake Michigan, according to Dr. Stanford H. Smith, Senior Investigator, Great Lakes Fisheries Laboratory operated by the University of Michigan.

A clear example of biologic form adaptation through genetics and natural selection to a changing environment, in this case a polluted environment, is shown by the industrial moth, in Great Britain. In certain heavily industrialized areas, the original moth was a bright colored phenotype and thus its coloration blend with its natural background, protected it, as a form, from preying birds. As air pollution colored the immediate world grey, these markings became a liability, but to be a drab, grey moth became an asset. The markings, of course, are genetically controlled. The environment thus selected for the "drab," they reproduced effectively, while the "bright ones," passed out of the population. Now the grey moth is the dominant industrial moth in these areas. The really starry eyed conservationist is not well versed in biology when he promotes his programs "to save the species," since extinction of species would occur in the process of evolution, regardless of man's efforts.

The rapid proliferation of interest in problems of our environment is reflected in a variety of meetings, and organization of scientific personnel with a common goal. An International Symposium entitled, "River Ecology and the Impact of Man," is being presented by the NE Division, American Fisheries Society, at Amherst, Massachusetts in June of 1971.

A symposium was held at the NBC on the Filing of Federal Environmental Impact Statements. Panelists included Dr. T. C. Byerly, USDA, Dr. Richard Davidson, Bettelle Memorial Institute, Mr. W. J. Holland, HEW, Dr. Thomas Kimball, National Wildlife Federation, Col. James Newman, Corps of Engineers, Dr. M. C. Patent, Department of Defense and Dr. Lee Talbot, President's Council on Environmental Quality.

There were seventy participants in an MIT sponsored, "Study of Critical Environmental Problems," conducted on Williams College Campus in July of 1970. Most attention was given to the impact of the SST on the environment. Their deliberations led them to believe no change is predicted in the ozone balance in the environment, as a result of SST flying.

The first Annual Report of the Council on Environmental Quality, a body established by the National Environmental Policy Act of 1969 was issued August 10, 1970.

That there is some confusion in the minds of individuals in positions of authority with respect to our efforts to maintain environmental control, is indicated by a comment from a recent newspaper article. An oil slick, caused by the Navy's dumping of some 500,000 gallons of sludge threatened Florida's beaches. Mr. Harmon Shields, Florida Director of Natural Resources said, "I don't know how much damage was done to our marine life. I don't know if we'll ever know. We will try to find out." Here comes the clincher, however: "I think the federal government should reimburse the State of Florida for damage to its resources." Presumably Mr. Shields feels he can recruit a sufficient number of scientists, lawyers and accountants to put a dollar value on damage that he does not find possible to quantitate.

The role of the tree in achieving ecological balance was accentuated recently by Mr. John A. Ball, President of U.S. Plywood Company. In 1930 the chief forester of the nation and USDA, predicted a timber famine within 20 to 30 years. Today, timber of a burgeoning third forest, larger than the forests of 35 years ago, is being harvested. Trees utilize carbon dioxide and carbon monoxide and produce oxygen. One acre of young trees releases 4 tons of oxygen into the air each year. Twenty healthy trees are capable of offsetting the pollution caused by one automobile.

Excessive emotion about detergents is manifest. The New York Times speaks of "Deadly Detergents." Actually today's phosphate detergents, effective and safe, may be replaced by ineffective,

toxic detergents. In *most* drainage basins of the country no serious problems arise from detergents. The majority of citizens may be inconvenienced or harmed by measures taken on the chance that a minority living near lakes might benefit. Massive algal blooms have occurred in lakes containing very little phosphate. The limiting nutrient often is carbon. Elimination of phosphates from detergents would not solve the eutrophication problem. If treatment of municipal wastes were properly managed, phosphates from human waste and detergents, would be simultaneously eliminated.

Men like Haagen Smit at Cal Tech have been preaching the Gospel of Environmental Control for 10 years. Their work became important when politicians and popular concern, predicted it could be used to political advantage and lend itself to development of rhetoric that would indicate deep concern to constituents, but not really require immediate action, nor immediate results.

A National Biological Congress was held in early November. The Congress was billed as a major effort in Scientific Communication. Topics such as "Response of the Body to Environmental Influences," "Environmental Microbiology," "Insects and Human Environments," "Contributions of Basic Biomedical Research to Human Welfare," "Social Implications of Basic Research in Developmental Biology," and a "Symposium on Ecology." This was a meeting where a nationally known demographer, Dr. Frank Notestein talked of a "cult" versus the Science of Ecology, Mr. Fred W. Bowditch of General Motors Corporation, said that industry could and would do what was necessary to avoid pollution, but they needed guidelines. He asked questions such as, "What level of purity is expected in the Detroit river? That purity typical of the 1950's, 40's, 30's, 20's?" He also made it clear that consumers and taxpayers (one and the same, getting hit from 2 sides, presumably) must be willing to pay the tab. Men like Gus Tyler of the International Ladies Garment Workers Union, made sincere, albeit heretical for a Union official, comments concerning the necessity for industry to discontinue a policy of manufacturing for obsolescence. The scientific community may be called upon to exert efforts to realistically predict pollution levels that man can tolerate and adapt to (recall the industrial moth). I might here draw an analogy to pressurizing airplanes. Clearly man has respiratory problems breathing at Altitude and thus flying at 30,000 feet calls for a pressurized cabin. He has no serious problem at 7 to 10,000 feet, however, and thus there is no point to pressurize an aircraft equivalent to the atmospheric pressure

at sea level, since from the standpoint of economy and engineering, it can be done more easily equivalent to 7 to 10 thousand feet.

Clearly, in spite of the rhetoric, pollution levels may be critical locally, but are not of serious proportions in many cases, country wide or global. One of our problems is that people want to "stay where they are." To ask people to move and thus maintain environmental control is not, nor has it ever been politically popular. Mr. Dulles found that out several years ago, when his off the cuff comment suggesting that unemployed persons should go where the jobs were, got him into boiling water.

Man's present, World Wide concern with pollution and attempts to change it with rhetoric, reflects his inability to really care about future generations. Perhaps it is a simple reflection of his immense selfishness or feeling of self-importance. We are like a large group who has enjoyed a sumptuous dinner, 8 courses, fine wines, and entertainment. It suddenly dawns on everyone, that somebody needs to wash the dishes. The cooks who prepared the food feel they've given the group what it asked for and thus feel no responsibility to clean up. The diners are too satiated, too comfortable to do it. Assuming they can, and are willing, both groups agree to pay somebody else to do it. Would that cleaning the environment were so simple.

One cannot question the existence of serious pollution problems in restricted areas. We might do well to determine quantitatively, if pollution levels originating from Man's activities are proportional or disproportional to his population. This, I would say, is realistic thinking that is biologically sound.

Recall that in our biological organization described earlier, the next highest level of organization, above the organism is that of population. The population is defined as a collective group of organisms of the same species occupying a particular space. Such a population has particular and varied characteristics which are the unique possession of the group, but are not characteristics of individuals making up the group. Density, natality (birth rate), mortality (death rate), age distribution, biotic potential, dispersion and growth form, for example are characteristics of a population.

Further, a population has "biological attributes" which it shares with its component organisms, and it has "group attributes" unique to its own group. The population, for example, has a life history, in that it grows, differentiates and maintains itself, and has definite organization and structure which can be described. This characteristic of the group, is also a characteristic of

the organism. Group attributes such as birth rate, death rate and age ratio apply only to the population, the group.

Population density is defined as population size in relation to some unit of space, i.e., 200 trees per acre, 5 million diatoms/m³ of H₂O, 200 lbs fish/acre of water surface. Crude density (number/unit of total space) is frequently distinguished from ecological density (number/unit of habitat space). If one fenced 1000 acres one might initially determine a rabbit crude density of 15/acre. Unless there was an adequate water supply, to support the habitat, however, the ecological density would be somewhat less.

Although population densities are variable, they are by no means infinitely variable. A forest might show an average of 10 birds/acre and 2,000 soil arthropods (insects)/m², but there would never be 2000 birds/m² or as few as 10 arthropods per acre! In stable ecosystems (as in stable physiological systems) homeostatic mechanisms operate to keep density of the common or dominant organisms within definite limits. Density will vary according to interaction with other species (competition) and action of physical limiting factors.

Population is a changing entity, we need to know its size and composition in one moment (impossible) and also how it is changing. Rate of change and change/period of time elapsed during the change, and the birth rate, equal to the number of births/year, are important parameters of population analysis. The growth rate of a population is the number of organisms added to the population per unit time, and birth rate is only one parameter of this total input. A population of 50 protozoans which increased to 150 after an hour has passed, calculates out to a percentage growth rate of 2/hr/individual. Some individuals, however, may have divided twice, some not at all, and others disappeared from the population. We have no knowledge of anything except change.

Natality (demography) maximum (absolute or physiological) natality is the theoretical production at maximal levels under ideal conditions, of no ecological limitations and reproduction limited only by physiological factors. This would be constant for a given population. *Ecological, realized* or simply "natality", refers to population increase under actual specified environmental conditions. It is not constant, but varies with size, composition of the population as well as physical and environmental conditions. It is customary to express natality in terms of rate/female and thus it must always be 0 or positive.

Maximum natality is the theoretical upper limit, the population is capable of producing under ideal

conditions. This is difficult to determine, but of interest to compare with realized natality. Being a constant, it can be used to set up equations to predict rate of increase in a population. Average reproductive capacity taken as a measure of natality (population) not the capacity of the most productive or least productive individual (i.e., as in protozoan example) is important to know. Darwin's calculations on elephants, the slowest of all breeders known might be worth looking at in this context. This animal begins to breed at age 30 and continues for 60 years, bringing forth 6 young in the interval and surviving till 100 years old. After a period of 740 to 750 years, there would be 19 million elephants alive, descended from the first pair. The difference between biotic potential and actual rate of increase is a measure of environmental resistance.

Mortality is the Antithesis of natality, deaths/unit time. Ecological mortality is the loss of individuals under a given environmental condition, and is not a constant. Theoretical minimum mortality is a constant for a population which represents the loss under ideal or nonlimiting factors. At best, individuals would die of "old age" (Geriatrics) determined by physiological longevity. Ecological longevity is far shorter than physiological. (It must become, whether we quantitate its factors or not, biologically speaking, the limiting factor in population levels).

Since mortality varies greatly with age, specific mortalities (% of initial population dying within a given time) at as many different ages, or stages of life history, as possible are of interest, inasmuch as they enable us to determine the forces underlying the crude, overall population mortality. This systematic analysis may be represented in the *Life Table*. Survivorship curves may be informative in terms of population per specified time interval (i.e., Figure 43, 3 basic types). If average physiological longevity were to be realized convex, sharp angled curve, all individuals live out their inherited life span and dying more or less all at once. (Starved fruit flies starved following pupation). If specific mortality rate is constant, survivorship curve is a straight, diagonal line (on semi log plot) as in the hydra. Concave curve indicates high mortality in youth, for example in the oyster when the free swimming larval stages are vulnerable. The shape of the curve is affected by density, the high density curve shifting to the left. Deer, for example, living in a managed area with food supply increased by controlled burning, have a shorter life expectancy than deer in unmanaged areas. Increased hunting pressure and intraspecific competition are two factors involved. Numbers may be greater (although individual deer smaller)

and thus from the standpoint of the hunter, the managed area may be most favorable. The individual deer, however, have a better chance for a longer life in the unmanaged (low density) areas. History records a number of parallels to this situation in human populations where high density was not always favorable to the individual longevity (epidemics).

Civilized man has greatly increased his own ecological longevity as a result of modern medical knowledge, better nutrition and other factors, so that man's curve approaches the sharp angled minimum mortality curve. He has not, however, increased his physiological longevity, since no more people live now to be 100 years old than did in past centuries. Most animal curves would be moderately concave between oyster and Hydra. Most plants closer to that of oyster. For many important economic species mortality is generally more variable and more affected by environmental changes within and outside the population, than its natality. Therefore, mortality plays a leading role in population control and systematic analysis of this factor becomes very important to the population ecologist.

Age distribution is a characteristic of a population which influences natality and mortality since the young have high breeding potential and the older have increased probability of mortality. Usually a high proportion of young individuals is indicative of a rapidly expanding population, even distribution of a stable population and a preponderance of old individuals a declining population.

Three ecological ages in any population and in individuals within the population, are defined as prereproductive, reproductive and postreproductive. Modern man spends about 1/3 of his life span in each age category. Potentially, however, he is biologically oriented to spend twice as long in the reproductive stage, as in the prereproductive or postreproductive stage. This "potential" is a part of our world wide problem of population explosion. Primitive man had a much shorter postreproductive period.

A population tends to develop a stable age distribution and a constant proportion of individuals at different ages. If this situation is temporarily disrupted by environmental change, the age distribution will tend to return to the previous distribution upon restoration of normal conditions.

When the environment is unlimited (space, food, other organisms not exerting a limiting effect) the % growth rate (population growth rate/individual) becomes constant and maximum. We speak of a biotic potential or reproductive potential in such a situation. The difference

between the biotic potential and the rate of increase in a laboratory or field condition, is taken as a measure of environmental resistance, which is the sum total of environmental limiting factors which prevent the biotic potential from being realized. The instantaneous reproductive rate per female, rice weevil, per week is 0.76, per year 39.6. The finite rate (number of times population would multiply in 1 week) equals 2.14, per year equals 1.58×10^{16} , at 29°C. At 23°C the last figure would be reduced to 5.34×10^8 and at 33.5°C equals 493. It is fortunate indeed, that we do not have to depend solely on physical factors or spray guns to keep insects in check. Population itself and other biological factors offer the most powerful overall check on populations.

The "J" shaped growth curve may remain flat or produce a relaxation oscillation, density triggered. Density variations, observed but poorly understood, are not related to seasonal or obvious annual changes, but regular oscillations with peaks and depressions every few years occurring with such regularity that peaks and depressions may be accurately predicted. Hudson Bay Company data on Lynx population peaks every 9.6 years, followed by rapid declines called "crashes". The data for the snow shoe hare, natural prey for the Lynx, falls on the same cycle with the peak preceding that of the Lynx by one year. A 3 to 4 year cycle of Lemmings, mice, voles and their predators, the snowy owl and foxes shows a similar correlation. Every 3 to 4 years the Lemmings increase to extremely large numbers only to "crash" in a single season. Foxes starve in large numbers and owls migrate south into the USA, sometimes as far as North Carolina. Few, if any Owls ever return to the Tundra. The Owl population "crashes" as a result of dispersal movement. The cause and effect in these changes are not clear.

Interspecific interactions represent a kind of environmental resistance to a population.

Population growth appears to pass through a series of stages. In the first stage, both birth rate and death rate are high and the population increases only slowly (10,000 years ago through the time of Christ to 1700). In the second stage the death rate falls sharply but the birth rate stays high. The population expands more or less explosively. (1700 through the present time, a logarithmic expansion). In the third state the birth rate falls sharply and finally both birth rate and death rates stabilize. Thereafter, the population grows slowly unless stimulated by some new development, new food sources or a change in ideas and values.

Man, albeit not discretely defined has been on earth some 2 million years. About 10,000 years ago, the population began to increase slowly. By the year 1, the time of Jesus Christ, there were about 250 million (1/4 billion) people in the World. By 1620, the time of the Pilgrim landings, human population had increased to 500 million. This doubling took 1600 years. By 1800, some 200 years later, the population doubled again and the next doubling took only 130 years (to 1930) and at that time, the world growth rate was about 1%. By 1960 the growth rate had gone to 2%.

Plagues of 1650 to 1700 caused 250 deaths/1000 or 25% mortality rates. Today in U.S. and Europe the mortality rate is 8 to 12 people/1000 or about 1%. In Colonial America the mortality rate was 55/1000 or about 5%. In India at the present growth rate there will be 1 billion people by 1994. This, in a country which in 1968 was unable to feed 1/2 billion.

Population: Population in the USA has reached 204,765,770, the gain from 1960 to 1970 being the second largest in history. The rate of gain, 13.3%, however, was the second lowest rate of any decade in history, the lowest being between 1930 and 1940, reflecting a nation in the throes of depression.

Some publicity was recently given to the "Census Clock" operated by the bureau of the census, Department of Commerce in Washington. The "clock" ticks off a birth every 8 1/2 seconds. 3 1/2 billion is an enormous number. Applied to people, that's enough to string out between Columbia and the moon, twice. At the present rate of increase, world population will double by the year 2000. One of the reasons that among elders in our society the "good old days" had advantages over the "now" world, was that they had fewer neighbors!!

10,000 to 12,000 people per day die of hunger in the world. Tomorrow morning there will be about the same amount of food in the World, but there will be 200,000 new mouths to feed.

Demographers divide the number of people added to a population by the number of groups of 1,000 already there to obtain a growth rate. A city of 5,000 increased by 50 has a growth rate of 10/1000.

A country with a growth rate of 1% means the population will double in 70 years. A growth rate of 2% indicates a doubling time of 35 years. Venezuela, for example, has a growth rate of 3.6 which indicates a population twice that presently determined, in 20 years. Natural disasters in the past, although tragic on a local basis, and the source of much real and vicarious suffering,

have not drastically affected world population. Earthquakes in China, Shensi province in 1556 claimed 830,000 lives; in Central China in 1887, 900,000 lives were lost in widespread floods. Volcanic eruptions claim relatively few lives. 30,000 in 1902 in Martinique and the combination of cyclone and tidal wave this year claimed only 2 to 300,000 lives in Bengal. The total loss of life due to military actions in World War II is estimated to be 15,000,000 plus those 2,200,000 listed as prisoner or missing in action. This does not include the 6,000,000 plus Jews killed by Germans and Russians between 1933 and 1945. In Rome in 262, 5,000 persons/day died, between 476 and 1400 some 60,000,000 in all perished from Bubonic Plague. As recently as the period 1894 to 1914, some 10,000,000 persons in India died from the Black Plague. Influenza claimed 430,000 lives in a six month period in the USA during World War I. Nor has famine made a significant dent in our population growth. 9,000,000 perished between 1877 and 1879 in China and another million in 1902. Famine is a way of life in India, 800,000 deaths in 1837, 1,000,000 in 1863 and another million in 1900. 750,000 people died (many more migrated to the USA) as a result of the potato famine in Ireland between 1845 and 1850.

Natural disasters then, although they claim the life of millions of lives *in toto*, have not really put much of a break upon population growth, world wide. Nor can natural disasters such as the world has thus far experienced, be expected to do so.

Ehrlich and Ehrlich state in their "Population. Resources, Environment" 1970, "No geological event in a billion years has posed a threat to terrestrial life comparable to that of human overpopulation."

Where population control is concerned, contraception by the "lite of the moon" and intrauterine devices (pebbles placed in utero in camels crossing the desert to prevent pregnancy) have been known for a long time. People really do not care.

Many problems of society are problems of behavior and human behavior, unlike animal behavior, is in turn conditioned by the fact that man has a soul, or thinks he has, or acts like he has. Thus, the Science Policy, or the efforts of science to carry out animal experiments and carry over intelligent training relevant to man, is fraught with difficulties, if not, in many cases, impossible. The carry over from animal work of findings in functional biology (physiology) is valid because whatever else man may be, philosophically speaking, he is clearly a mammal, biologically speaking.

Some form of National family planning program exists in 25 countries including India and Tunisia. Birth control may be manipulated through use of intrauterine devices, steroids; "once a month" pill with menses inducing properties; male contraceptive pill; draconian agents such as an additive to drinking water.

The extent of implications of unwanted fertility needs to be recognized. Any efforts of society to regulate population (i.e., Zero rate of population growth) assumes the elimination of all "unwanted" children. 1/5 of all births and more than 1/3 of negro births, between 1960 and 1965, were unwanted as determined by a questionnaire to 5600 married women. 1/3 of all 4th order births and 1/2 of all 6th order (or higher) order births were unwanted.

Even if the Society of Man was to reduce the present birthrate of 40/1000 population to 20/1000 by the year 2000, well over 1 billion births must be averted in the developing world alone. What we must understand is that even if an average family size of 2 children per couple is achieved, the population will continue to grow for an additional 65 to 70 years and the ultimate stabilized level will be far greater than at the time the 2/couple rate is achieved. If, for example, by the year 2000, developed countries were to reach the point at which couples replaced themselves, and developing countries were to reach the point at which couples replaced themselves, and developing countries reached that point by the year 2050 (both achievements unlikely) the world's present population of 3.5 billion would not become stationary before the year 2120 and would then stand at 15 billion.

The manner in which the gradual slowing in our growth rate, and thus ultimate population control is achieved in these USA may include the following. In intellectual acceptance that we live on a spaceship with limited, finite environment. A rejection of the idea that each person can take as much as he wants from the "commons." Cessation of immigration. We are a wealthy country, but if all the poorer people of the world move in, it will not be so much a matter of sharing the wealth, as sharing the poverty.

Taxing schemes for rewarding people who do not have children and for those who adopt children may be formulated. Changes in the direction of coercion exercised on welfare recipients, reflecting the idea that the freedom to have children makes sense only if the person can take care of them himself. We must also face the problem of optimum population. Economists presently are "growthmanship" oriented. Some consensus on values must be made. Shall we have more wilderness or more food for people?

Zero population growth may become acceptable, but inherent here is acceptance of the idea of control of breeding. If we define the optimum and find that we passed it last year, or five years ago, we might begin a program of negative growth. Once the concept of control of breeding is accepted, both zero and negative growth are possible since both involve control.

We must, perhaps after 1986, consider the limiting of life span. It is now possible to postpone through extraordinary measures, every death which occurs in a hospital setting. Do we want that? When is a patient entitled to die with dignity?? When one starts on zero population growth, and more so on a negative growth program, one discovers that for purely statistical reasons, there is realized a great increase in the average age of the population. People will ask, "Do we really want a population that is on the average, 65 or 70 years of age? This will be a difficult question to resolve in a democracy!! This is one of the tragedies of these musings!! Implementation implies a totalitarian government and thus a loss of freedom. Finally, the moral question of "Who shall Judge," raises itself. Positive eugenics might be practiced (once control is accepted) where breeding is encouraged in some groups instead of merely discouraging that of others. This is the kind of solution that might be expected from a purely scientific mind where *a priori* every problem must have a solution. Additives placed in food could control people: tranquilizers, memory blocking agents, anti fertility drugs and distribution in turn controlled by governments. Because man will have to employ technological means to survive, "Rule by the Elite" (Scientists and Technocrats) may be a realistic possibility. Presumably an unarmed citizenry and arms available to scientists in authority could get the job done. I detect some degree of these sentiments in talking with anti-pollution people.

Historical events do have striking effects at times, in starting things moving, whether certain things happen or not. They alter the time schedule greatly, for example Sputnik I.

What are the possible events that would effect our activity and action in that field of population control? Genocide and its political impact! Blacks, in connection with birth control programs have already raised the issue. It is curious that black men raise the issue of genocide, and black women (who have the children) have not. This will hasten thinking along these lines and initially decrease the extent to which we are willing to control populations.

Massive famines some places in the world. A famine in which 50 million or more people die

will have an effect on birth rate in more conscious countries where conscious control is more easily possible. If brain tissue is malnourished, with respect to protein, at early stages of development, after reinstitution of proteins in the diet, it may be biologically impossible for many of them to recover intellectually. Some of us may have given money for Biafran children.

Massive social disorder. People living in times of great disorder hesitate to bring children into the world. Serious, but not devastating thermo-nuclear War. A feeling might develop that there was somehow a connection between population growth and War. (Perhaps there is since violence is correlated with crowding). A massive pollution disaster. A spectacular disaster in the space program, sooner or later will occur. We'll have men on the moon, as we've had them at the North Pole, South Pole or atop Mt. Everest, and there they will stay. This will reemphasize that we really do live on "space ship earth" and really cannot dream of evacuating it when life here becomes untenable. This would tend to effect a decrease in population growth. A welfare program scandal would tend to decrease population by causing the adoption of repressive measures.

For at least 60 years, men have believed that a "just" (whatever that means) distribution of wealth could be achieved among nations, while populations continued to grow and per capita incomes continued to rise in the west. The Scenario of gap closing, population growth and ever rising production is an illusion, for its 3 elements are mutually insupportable in a finite world with limited resources. The West already imports more minerals, fuels and proteins than it exports. Is it not a kind of madness then to cling to this narrowly effective ideology that the west can continue to gain wealth and simultaneously help other regions to approach its own standard of living? The World supply of ores of most industrial metals, would be exhausted long before the whole world could build a level of industrialization comparable to that of the United States. The richer a society aspires to become, the fewer additional people it can support in conditions of freedom and health. If in 30 years, the population of the world were only 5 billion (rather than the more probable 7 billion) and the prosperity level were equal to that of the USA, there would be: 2,400 million motorcars on the road. It is suggested we look to the seas and fresh water fisheries, but in fact they have long since captured our attention. The annual levy on wealth from the sea has risen from a catch of 5 million metric tons in 1900 to 64 million in 1969. Despite the immense progenitive powers of the plankton in water, owing to the great losses

of energy at each link of the food chain, it takes about 100,000 pounds of algae to produce 1 pound of cod fish.

World population increases by 200,000 every 24 hours. Disposal of bodily and industrial wastes, increased use of heat energy generated largely from fossil fuels, for example adds tonnages of contaminants per year. How many people, really, can our biosphere decently support?

A report of a study commission headed by former Canadian Prime Minister Lester B. Pearson, funded by the World Bank, indicates that no other phenomenon casts a darker shadow over the prospects for international development than the staggering growth of population. No serious social economic planning can be accomplished unless the ominous implications of uncontrolled population growth are understood and acted upon.

Over 2 billion of the world's 3.5 billion people live lives dominated by extreme shortages of food and water and by inadequate resources in soils and forests. A luxury club, by contrast, of 400 million people enjoy a rich and steadily more abundant diet and high living standard. Between these poles are millions who manage well enough despite many handicaps on a barely adequate, monotonous diet and live a parsimonious life.

Some Marine Scientists suggest plankton as our ultimate security against global famine. Exploiting it, in addition to an enormous cost factor, might be foolhardy, since a cubic meter of seawater contains a cubic centimeter of algae substance which is unfit for human consumption in its raw form. Two thirds of commercially prized species of Atlantic fish depend in some way upon the marshes of our coast. We've already lost 7% of these marshes to dredging, filling, trash disposal, oil spills, pesticides and other chemicals. Real Estate developers threaten much of the remainder.

The hardest choices we have to make are those between alternatives which both seem right and good. Do we wish to see an ever rising human population? Do we wish to go on getting and spending at ever higher levels? Or, as we prefer to believe about ourselves, do we truly seek a more equitable world in which all people can claim their due share of the earth's bounty? We cannot, because whatever else we are, we are also mammals in a biospheric community, have it both ways!

Dr. Lewis W. Moncrief, Assistant Professor, School of Forest Resources, N. C. State University, sees a cultural basis for our environmental crisis. The Judeo-Christian tradition conceives of man as superior to all other creation and of everything else as created for his use and enjoy-

ment. Capitalism and its science and technology, democratization and its urbanization, increased wealth, increased population and individual residence ownership, not only characterize the Judeo-Christian tradition, but all lead, to varying degrees, to environmental degradation. 700 million poor people in China are less of a hazard to the environment than 700 million rich people. The rich, in any land, occupy more space, consume more of each natural resource, disturb ecology more, litter the landscape and create more pollution.

Man tries hard to maintain "control of his environment" because he feels that he is intellectually able to control his environment!! Maybe he is not! Maybe he loses his perspective that he's a part of a biosphere and he cannot continually have what he wants, without a really drastic "crash" reduction in population. The belief that he can have his cake and eat it is either a sign of his relative immaturity (i.e., that emotional, social, spiritual man never really has caught up with intellectual man), or an intellectual overkill.

Doomsday predictions have been popular since political times, only the sources of Doom change. Destruction by a large asteroid, or by radiation from a nearby Supernova or Solar Superflare, does not evoke much concern. This is surprising since although remote, these possibilities are finite. Famine, War and Pestilence are "old hat" and people have learned to live with them. The current fad is to predict ecological disasters. We should not cry "wolf" needlessly, nor too often. Scientific credibility can easily be lost by exaggerated claims and extravagant statements. As scientists we have the responsibility to speak up, but we also must know when to "shut up". (For a while there was great concern that we would run out of oxygen because of the burning of fossil fuels. This particular concern was laid to rest recently and conclusively by Dr. W. S. Broecker's article in *Science* 168 1537 (70). Another concern for global oxygen came from the possible effect of DDT on phytoplankton of marine waters, but is judged to be a problem no more (see J. H. Ryther, *Nature* 227 (1968). While there has been an actual increase in the CO₂ content of the atmosphere, the "greenhouse effect" of climate warming has been small, and even negative, because of the overwhelming effects of atmospheric dust which tends to cool the atmosphere. Even the long range effects of CO₂ are likely to be reduced, partly because of the buffering action of the ocean, and partly because of the increased photosynthetic absorption and storage by forests, while a limit to CO₂ production is also set by the

prospective exhaustion of fossil fuels (S. F. Finger, *Sci. Amer.* 223 (1970)).

A scientist or an engineer attacking a problem assumes as a "matter of course" that the problem has a solution. This may be simply a reflection of his personality, training and "bent" and his naivety in the subject matter of philosophy and theology. To say that a problem has a solution does not make it so, although it certainly leads in some cases, to weird experimental design! I learned the following quote a long time ago, but no not recall its author.

"Blessed are those who never doubt their own knowledge; they live in peace and never learn. A doubting mind is difficult to live with."

Man desperately needs the compassion that is the hallmark of deep religious conviction. Man may adulterate and reinterpret to his own detriment, theological writings and philosophies of any faith, so that the outcome of crusades seem not to reflect compassion, and man might well say as does "Flip Wilson", "The Devil made me do that," but most of these ancient manuscripts go to great lengths to emphasize the need for love and compassion (neither of which are biological) for one's fellowman.

Perhaps man's nemesis is neither his capacity to destroy himself through atomic warfare, nor his unwillingness or incapability to halt the destruction of his environment, but rather his profound faith in cerebral capacity that he "can do." Willingness to "give it the old college try," is an admirable trait in any person and certainly an essential ingredient to a successful life. On the other hand we all know there are some things we cannot do. Few of us can run a 5 minute (15 minute) mile!! The ability to clearly discern between what one can do under a given set of conditions, is as important as the capacity to "press toward the mark" once the discernment has been made. One of the differences between psychotic and nonpsychotic is that the latter recognizes dreams for what they are. One might suppose sleep and wakefulness was a continuum! Supposing Man (in the larger sense) became so convinced that all of his problems were soluble through the application of thought processes from an infallible mind. Would man in toto not become a kind of schizophrenic congregation of single minded individuals, with a single devise for problem solution, bent on their own destruction? The cerebration of man which separates him from other animals may be his undoing.

The mammalian World was, for a long time, constricted and impoverished by the dominance of the now vanished reptiles. Similarly, who

knows at the present time, what beautiful product of creation remains potential only because of our continued existence; of what renewed manifestations of creative energy our own presence holds back, or has perhaps destroyed forever.

By far the greater proportion of once living branches on the tree of life are dead, and to this the archaeologist and historian must add dead stone, dead letters, dead ideas and dead civilizations. And yet, Life, the golden strand of our universe, goes inexorably on!

In organic evolution 3 facts, so far as is perceptible today, seem to determine the death of a species (1) the irreversibility of the organic process in time (2) High specialization which, in the final analysis, limits new adaptive possibilities and (3) the sudden emergence of spectacular enemies or OTHER environmental circumstances which so completely and suddenly overwhelm a living form that the slow adjustive process of natural selection cannot be made to function.

The more completely adapted an organism becomes to a given environmental situation, the less capability it has to cope with a change in its environment.

Like children who see no end to pleasantness and goodness, the first scientific years of man was characterized by seemingly incurable optimism. Oswald Spengler documented the onset of doubts early in this century in his "Decline of the West," however. He was certainly right when he indicated the hallmark of this century would be the rise of Dictators, great wars and augmented racial strife. Was he also right in foreseeing the 20th Century as the onsetting winter of civilization??

No one to date has been quite able satisfactorily to account for that series of rhythmic and overwhelming catastrophes which we call the ice age. Although we no longer cloak such mysteries in an aura of supernaturalism, they continue to remind us of the latent forces still lurking within nature.

Another of these episodes is reflected in the origins of the human mind, a quantum step: the emergence of genuine novelty in nature. This other intangible, world of fantasies, invention flowing thru the heads of men since the first ape man succeeded in cutting out a portion of his environment and delineating it in a transmissible word. A world arose, with that word, that will die only when the last man utters the last meaningful sound.

A unique world rests behind the foreheads of men. 2000 years ago in the deserts of Judah, men acknowledged that the instinctive world of animals had been lost to man. He was to move

across the landscape, a wanderer, in a sense, apart from nature. Fickle erratic, treacherous, he would create from stone and ore, untold powers. Great music and art would give him temporary moments of peace, while even in these moments, temptation and terror were his companions. He was capable of believing all things and yet, nothing. He would torture and kill, for nebulous, poorly discerned ideas, more ferociously than other creatures kill for food, and then in a generation or less, forget the purposes of his dream of blood and murder.

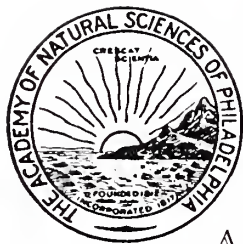
We are imperfectly adapted, lost between an instinctive mental domain and a realm of thought which drift shadows of our primordial past. Man stands on earth between 2 desperate kingdoms: the flesh and the Spirit.

As for every action there develops reaction, the unifying efforts of man seem always to be opposed by a tendency to disruption. Eternally he builds, and yet across these Towers of Babel there runs this ancient fault, a primordial flaw out of old time. We, of this age, have not escaped it. It is worth suggesting in passing, that perhaps no existing society has built so much on so little.

Man's optimism and self esteem leads him to think in terms of extinction of other animals. One technician writes concerning insecticides. "After all, the dinosaurs disappeared. Man merely makes the process go faster. We shall learn to get along without birds if necessary. Everything changes with time." And so it does. It may be we who go, not the birds. If we should so mishandle our own lives, as several civilizations before us have done, it seems a pity (and highly improbable from a biological standpoint) that we should involve the violet and tree frog in our departure.

The obstacles lie in the minds of men. Too many millennia of tribal suspicion and hostility are still at work in our subconscious minds. We are, in fact, an inescapable community, united by the forces of communication and interdependence in our new technological order. We must apply world wide, a moral responsibility, spirit of sharing, standard of justice and compassion, without which family, local, state and national societies will surely fall apart.

The challenge of the scientific revolution is not a large technological conundrum like putting a man on the moon, but a straight forward moral obligation of "care" for one's fellowman. We can meet this challenge if we have the wisdom and moral energy (neither alone will get the job done) to do so. If we lack these combined qualities, man may lack the means of survival on this planet.



Catalog of the Library of the Academy of Natural Sciences of Philadelphia

THIS DICTIONARY CATALOG, which includes many analytic entries, finds its strength in systematics, paleontology and stratigraphic geology as well as limnology, marine biology, ecology and animal behavior. Miss Ruth E. Brown, Librarian of the Academy of Natural Sciences of Philadelphia, has provided the following description of this catalog:

When the Academy of Natural Sciences of Philadelphia was founded in 1812, one of the first orders of business was the establishment of a library collection for the use and instruction of its members. The collection grew rapidly, through exchange of publications with scientific societies and institutions and through generous gifts from Academy members. Over the years it has reflected the broad and varying scientific interests of the Academy. Today, the Academy's primary interest is systematic biology. Its library is an exceptionally complete collection of taxonomic literature, a great national resource collection.

The collection numbers approximately 150,000 volumes, strong in systematics, paleontology and stratigraphic geology. A number of years ago, the library of the American Entomological Society was deposited in the Academy's library, greatly enriching the Academy's holdings in entomology. Recent interest of the Academy's staff in limnology, marine biology, ecology and animal behavior has broadened the collection to include significant holdings in these fields. The library is noteworthy for its many finely illustrated monographs, complete sets of early journals, long runs of the serials publications of scientific societies and publications of foreign geological surveys. It includes approximately 700 titles published before 1750, the earliest imprint being 1527. There are currently some 3000 serial titles being received.

The entire collection was recatalogued according to the Library of Congress classification system under the direction of Dr. Venia T. Phillips and is a dictionary catalog including numerous analytic entries.

Supplementing the collection of published works is a manuscript collection of more than 200,000 items. It consists of the archives of the Academy, field notes and diaries, correspondence of eminent naturalists and pictorial works. The contents of the manuscript collection have been published in *GUIDE TO THE MANUSCRIPT COLLECTIONS IN THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA*, by Venia T. and Maurice E. Phillips, and the Academy's archives have been published in microfilm under a grant from the National Historical Publications Commission.

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QH 41 P49 Petiver, James, c. 1658-1718. <i>Jacobi Petiveri opera, historiarum naturalium aëneantialium continens several thousand figures of birds, beasts, fish, reptiles, insects, shells, Linnean corals, and fossils; also of trees, shrubs, herbs, fruits, fungus's, mosses, sea-weeds, etc. from all parts, adapted to Ray's History of plants ... to which are now added seventeen curious tracts ... The additions corrected by the late Mr. James Emsayon</i> ... London, John Millan. c1693-1767. 2 v. plates (pt. col.) 38 cm. For contents, see Br. Mus. (nat. hist.) Catalog. v. 4, p. 1567-8. Title-paged dated... 1767.	QH 1 S 71 Sociedad Geológica del Perú. <i>Boletín</i> t. 1-25. Lima, 1895-1920. 25 v. in plates, fold. maps, diagrs. 22 cm. Indexes: Vols. 1-18 in v. 18. For later Entries see Kardex	QH 1 S 71 Academia nauk SSSR, Leningrad. <i>Acta academicae scientiarum imperialis petropolitanae</i> [v. 1-6] 1777-1782. Petropoli, Typis academicae scientiarum, 1778-1986. 6 v. in 12. pls., tables, diagrs. 25$\frac{1}{2}$ cm. Each volume consists of 2 volumes. Superseded its Nov. commentarii, superseded by its Nova acta, QH 1.1 Text in French. A 42. Later designated Its Mémoires ... Série 3.
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Cave Research Fellowship Announced

The Cave Research Foundation will award a Graduate Fellowship for thesis research in the biological, social, economic, or earth sciences for the academic year 1972-1973. The annual stipend is \$500.

The Cave Research Foundation is a non-profit organization incorporated in the Commonwealth of Kentucky with the objectives of supporting karst-related research, interpreting karst features, and conserving karst features.

The fellowship is offered to support scientific studies related to limestone karst areas anywhere in the world. Proposals involving surface and/or underground work are acceptable. Although the stipend is administered directly between the investigator and the Cave Research Foundation, the study itself is to be supervised at the graduate school of the awardee's choice by his thesis advisor.

In addition to the stipend it is possible for the Foundation to provide field support for work in the Central Kentucky Karst and, through the cooperation of the Ozark Underground Laboratory, in the karst area near Forsyth, Missouri. Both areas can provide modest housing, field assistants, and some surface laboratory facilities. If the applicant envisions need for facilities in either karst area, then he should include the specific requirements in his study proposal. In addition field support may be available in the Carlsbad area.

If you have or know of students engaged in or preparing to initiate thesis research related to limestone karst, please encourage them to apply for this Fellowship. They should submit in triplicate the study proposal, a personal resume, and a detailed academic history to:

Dr. William B. White, Chief Scientist
The Cave Research Foundation
542 Glenn Road
State College, Pennsylvania 16801

Two letters of recommendation are also requested. One of these should be from the student's thesis advisor.

The application should be postmarked not later than 1 March 1972. The award will be announced April 1st.

The ASB

BULLETIN

Volume 19, Number 2

April 1972



*The Official Quarterly Publication of
The Association of Southeastern Biologists*

The ASB Bulletin is the official quarterly publication of the Association of Southeastern Biologists, Inc., and is published at Philadelphia, Penna., in January, April, July and October. Letters, news items, other contributions, and all communications about editorial matters should be addressed to C. W. Hart, Jr., Editor, The Academy of Natural Sciences of Philadelphia, 19th and The Parkway, Philadelphia, Pa. 19103. Change of address should be sent promptly to the Secretary of the ASB, Margaret Gilbert, Florida Southern College. Subscription orders from libraries and other institutions should be sent to the Business Manager, Dr. Ray O. Flagg, Carolina Biological Supply Co., Burlington, North Carolina 27215. Subscription rate for non-members of the ASB: \$4.00 per year. Printing and typography by the Fulton Press, Inc., Lancaster, Pa.

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CONTENTS

Association Affairs	30
Program of the 33rd Annual Meeting of the Association of Southeastern Biologists	31
Abstracts of Papers Presented at the 33rd Annual Meeting of the Association of Southeastern Biologists	49
Univ. of Virginia Announces Mountain Lake Courses	113
Wildflower Pilgrimage to be Held 4-6 May	114
West Virginia Univ. Announces Biological Station Program	114
Treasurer's Report, ASB, 1 Jan. 1971 - 31 Dec. 1971	115
ASB Candidates for Offices - 1972	119
Map of Mobile, Alabama	120

THE COVER

Part of a set of wood-block prints of representatives of the major insect orders, executed by Dr. Selwyn Roback of the Academy of Natural Sciences of Philadelphia. Not shown are the caddisfly and the hellgrammite. The prints, each roughly 10 inches in diameter and printed in color on rice paper, may be purchased from Dr. Roback for \$5.00 each.

ASSOCIATION AFFAIRS

NOTES FROM THE PRESIDENT

There are certain items concerning Association affairs that should be brought to the attention of the membership. As there are now more than 1500 members of the Association of Southeastern Biologists, it is becoming more and more difficult to keep everyone informed. In this regard, our Bulletin can be used to good advantage; this is not a precedent, as some years ago Dr. Victor Greulach made comments in the Bulletin concerning the affairs of ASB. Hopefully, the items presented here will be of interest to the membership.

An interim meeting of the Executive Committee of ASB met in Atlanta, Georgia October 9, 1971 and a number of items were discussed. Some of these, taken from the minutes of that meeting:

The annual meeting in 1972 will be at the University of South Alabama at Mobile, Ala., April 6-8. This has been announced and the call for papers mailed. You may be interested in knowing future meeting places and contemplated sites. In 1973 we meet at Western Kentucky, April 12-14; in 1974 at Georgia Southern College, April 18-20. In 1975 the Executive Committee recommends Virginia Polytechnic Institute and State University, April 17-19. Although the 1974 and 1975 meetings have been

(continued on page 112)



Program of the 33rd Annual Meeting of the Association of Southeastern Biologists

A joint meeting with the Southeastern Division of the American Society of Ichthyologists and Herpetologists, the Southern Section of the American Society of Plant Physiologists, the Southeastern Region of the Beta Beta Beta National Honorary Biological Society, the Southeastern Society of Parasitologists, The Southern Section of the Botanical Society of America and the Southern Appalachian Botanical Club.

THURSDAY, APRIL 6

- | | | |
|-------------|--|---|
| 8:00- 7:00 | Registration and Information: Building 173
Fees: Registration — \$2.00
Banquet: — \$5.00. Deadline: Noon
Friday, April 7.
Registration for Field Trips.
Message Center — Telephone (205) 438-2268 | |
| 10:00 A.M. | Executive Committee Meeting: Association of Southeastern Biologists. Conference Center Lounge | |
| 12:00- 5:00 | Placement Service: Building 182, Room B | |
| 12:00- 5:30 | Exhibits: Building 182. | |
| 1:00- 5:00 | Paper Sessions:
<i>Animal Ecology, Session I</i> , Bldg. 170, Room A
<i>Ichthyology and Herpetology, Session I</i> , Bldg. 170, Room D
<i>Plant Physiology, Session I</i> , Bldg. 252, Room A
<i>Plant Physiology, Session II</i> , Bldg. 252, Room B | <p>5:00 P.M. Executive Committee Meeting: Southern Section, American Society of Plant Physiologists. Bldg. 252, Room D</p> <p>7:30 P.M. General Session: Association of Southeastern Biologists, Main Hall, Conference Center
Address of Welcome: Dr. Frederick P. Whiddon, President, University of South Alabama
Response: Dr. Grover C. Miller, President, A.S.B.
Invitational Address: Dr. Walter Anlengen, Curator of Herpetology and Chairman, Department of Natural Science, Florida State Museum, <i>The Predator Dynamics of The Komodo Dragon</i></p> <p>9:30 P.M. Smoker: Conference Center Lobby and Lounge</p> |

FRIDAY, APRIL 7

- 7:00 A.M. **Breakfast and Business Meeting for The Southeastern Section, Botanical Society of America and The Southern Appalachian Botanical Club:** ERDC Cafeteria.
- 8:00 A.M. **Past Presidents Breakfast:** ERDC Cafeteria
- 8:00- 1:00 **Registration and Information:** Building 173
Registration for trips
Banquet reservations
Message Center. Telephone (205) 438-2268
- 8:00- 5:00 **Placement Service:** Building 182, Room B
Exhibits: Building 182
- 8:00-11:00 **Paper Sessions:**
Aquatic Ecology, Session I. Bldg. 170, Room B
Animal Ecology, Session II. Bldg. 170, Room A
Animal Physiology, Session I. Bldg. 170, Room C
Cryptogamic Botany, Session I. Bldg. 171, Room C
Developmental Biology & Anatomy. Bldg. 168, Room A
Ichthyology and Herpetology, Session II. Bldg. 171, Room A
Ichthyology and Herpetology, Session III. Bldg. 170, Room D
Parasitology, Session I. Bldg. 171, Room D
Plant Ecology, Session I. Bldg. 252, Room C
Plant Physiology, Session IV. Bldg. 252, Room A
Plant Physiology, Session V. Bldg. 252, Room B
Plant Taxonomy, Session I. Bldg. 171, Room B
- 8:00- 1:00 **Beta Beta Beta Paper Sessions:** Conference Center Lounge
- 11:00-12:00 **Business Meeting, Association of Southeastern Biologists**
- 12:30 P.M. **Luncheon and Business Meeting, Association of Southeastern Parasitologists,** Siesta Room, Malaga Inn
- 1:00- 5:00 **Paper Sessions:**
Aquatic Ecology, Session II. Bldg. 170, Room B
Animal Ecology, Session III. Bldg. 170, Room A
Animal Physiology, Session II. Bldg. 170, Room C
Cryptogamic Botany, Session II. Bldg. 171, Room C
Cytology and Genetics. Bldg. 252, Room B
Ichthyology and Herpetology, Session IV. Bldg. 170, Room D
Invertebrate Zoology. Bldg. 171, Room A
Parasitology, Session II. Bldg. 171, Room D
Plant Anatomy & Morphology. Bldg. 168, Room A
Plant Ecology, Session II. Bldg. 252, Room C
Plant Taxonomy, Session II. Bldg. 171, Room B
- 2:00 P.M. **Symposium: Net Carbon Dioxide Assimilation in Higher Plants.** Bldg. 252, Room A
- 5:15 P.M. **Business Meeting, Southern Section American Society of Plant Physiologists.** Bldg. 252, Room A
Business Meeting, Southeastern Section, American Society of Ichthyologists and Herpetologists. Bldg. 170, Room D
- 7:30 P.M. **Banquet and Presentation of Awards:** Main Hall, Conference Center.
Association Research Prize. Sponsored by Carolina Biological Supply Company.
Meritorious Teaching Award. Sponsored by The Association of Southeastern Biologists.
Outstanding Graduate Student Award. Southern Section American Society of Plant Physiologists. Presentation by Dr. P. W. Morgan.
Past President's Address. The Biologist's Responsibility To Industry: The Need for Reason and Understanding by C. W. Hart, Jr.

SATURDAY, APRIL 8

- 8:00 A.M. **Field Trips:** At press time the following trips had been planned. Additional trips may be formalized by the time of the April meetings. Details of all trips will be available at the Registration Desk.
1. **Dauphin Island.** Leader: Dr. C. G. Jackson, Jr. Bird sanctuary, Fort Gaines, dunes area and island flora and fauna.
 2. **Bellingrath Gardens.** Formal gardens and natural area. Special rates have been provided by the management for participants in the April meetings.
 3. **Pitcher Plant bogs.** A near-by area with interesting population of carnivorous plants. Dr. Ken Rogers, leader.
- 8:30 A.M. **Executive Committee Meeting.** Association of Southeastern Biologists. Lounge, Conference Center.

SCHEDULE OF PAPER SESSIONS

THURSDAY AFTERNOON - APRIL 6

ANIMAL ECOLOGY, SESSION I

Building 170, Room A

Presiding: Dr. Tom Rogers, University of Alabama

- | | | | |
|------|---|------|--|
| 1:00 | 1. JAMES H. ARRINGTON, University of Georgia and Albany State College. Effects of chronic gamma radiation on house mouse. <i>Mus musculus</i> (Mammalia: Rodentia: Muridae) population. | 2:38 | Break |
| | | 2:52 | 8. CHARLES E. POWELL, JR., SAMUEL L. H. FULLER, AND C. W. HART, JR., University of Pennsylvania and Academy of Natural Sciences of Philadelphia. Some advantages and disadvantages of a multiple-plate conservation webbing artificial substrate as a supplement to hand collecting of macroinvertebrates in Chesapeake Bay. |
| 1:14 | 2. PAUL R. RAMSLY, Savannah River Ecology Laboratory. Ecological genetics of <i>Peromyscus polionotus</i> (Mammalia: Rodentia) and a model of population regulation. | | |
| 1:28 | 3. ROBERT H. GARDNER, JR., Savannah River Ecology Laboratory and North Carolina State University. The relationship between age of grouping and open-field behavior of the prairie deer mouse, <i>Peromyscus maniculatus bairdii</i> . (Mammalia: Rodentia). | 3:06 | 9. GENE LORTON, Hampden-Sydney College. A simple apparatus for delivering a heat shock to microscopic aquatic organisms. |
| | | 3:20 | 10. JERRY C. SMRCHEK, Virginia Polytechnic Institute and State University. Zooplankton observations of two Maryland freshwater ponds. |
| 1:42 | 4. MICHAEL H. SMITH, Savannah River Ecology Laboratory. Biochemical definition of the <i>Peromyscus leucopus</i> — <i>P. gossypinus</i> species group (Chordata: Mammalia: Cricetidae). | 3:34 | 11. EDWIN E. HERRICKS, The John Hopkins University. Faunal fluctuations in enriched process waters. |
| | | 3:48 | 12. JOSEPH E. BOURQUE, Savannah River Ecology Laboratory and Wake Forest University. Population dynamics of a parasite, <i>Neoechinorhynchus pseudemydis</i> , the yellow-bellied turtle, <i>Pseudemys scripta scripta</i> in a reservoir receiving thermal effluent from a nuclear reactor. |
| 1:56 | 5. C. KENYON WAGNER, University of Georgia. Removal of rodents from a forest-field ecosystem by predators. | | |
| 2:10 | 6. MICHAEL P. FARRELL, Mississippi State University. Interspecific modeling and variation in mammalian water consumption. | 4:02 | 13. WILLIAM H. WALKER, JR. AND W. D. BURBANCK, Emory University. The ecology of an intergrade population of <i>Hexagenia munda marilandica</i> and <i>H.m. elegans</i> (Ephemeroptera) in Stone Mountain Lake, Georgia. |
| 2:24 | 7. JAMES G. WIENER, Savannah River Ecology Laboratory. Relative efficiency of four small mammal traps. | | |

ICHTHYOLOGY AND HERPETOLOGY, SESSION I

Building 170, Room D

Presiding: Dr. James Williams, Mississippi State College for Women

- | | | | |
|------|--|------|--|
| 1:00 | 14. JAMES G. SAXON, Erskine College. Reproduction and fat body cycle of <i>Cnemidophorus tessellatus</i> . | 1:42 | 17. J. WHITFIELD GIBBONS, Savannah River Ecology Laboratory and University of Georgia. Geographical variation in reproductive attributes in the mud turtle <i>Kinosternon subrubrum</i> (Reptilia, Chelonia, Kinosternidae). |
| 1:14 | 15. GARY C. SMITH, Furman University. Methods of measuring energy flow in reptile and amphibian predators. | | |
| 1:28 | 16. JOHN M. DAVIDSON AND ROBERT H. MOUNT, Auburn University. Geographic variation in the pond slider, <i>Pseudemys scripta</i> , in Alabama. | 1:56 | 18. MICHAEL W. DIX AND JAMES I. RICHARDSON, University of Georgia and Little Cumberland Island Association. |
| | | 2:10 | 19. JOHN C. AVISE AND G. BARRIE KITTO. Phosphoglucose isomerase gene duplication in the bony fishes: An evolutionary history. |

- 2:24 20. DAVID M. DEAN, University of South Alabama. Osteology of the eel *Myrophis punctatus* (Osteichthys, Anguilliformes, Ophichthidae).
- 2:38 21. THOMAS C. LEWIS, The Florida State University. Aspects of the biology of the spiny searobin, *Prionotus alatus* (Pisces: Triglidae), from the Northeastern Gulf of Mexico.
- 2:52 Break
- 3:06 22. STEPHEN A. BORTONE, Institute of Marine Sciences, University of North Carolina. Age and growth of the sand perch, *Diplectrum formosum*, (Pisces: Serranidae) from North Carolina.
- 3:20 23. ROBERT L. SHIPP, University of South Alabama. Competition between Atlantic and Pacific pufferfishes with possible extirpation of species along some Atlantic shorelines.
- 3:34 24. RALPH MARTIN, University of West Florida. Notes on the parasites of Choctawhatchee Bay catfishes.
- 3:48 25. ROBERT W. HASTINGS, Florida State University. Patterns of occurrence of reef fishes in the northern Gulf of Mexico.
- 4:02 26. BENNIE A. ROHR, Southeast Fisheries Center Pascagoula Laboratory. Size and sex segregation of offshore hake, *Merluccius albidus* (Mitchill) in the Gulf of Mexico.
- 4:16 27. DAVID S. PETERS, National Marine Fisheries Service. Feeding selectivity in juvenile Atlantic menhaden.
- 4:30 28. WILLIAM E. SCHAAF AND GENE R. HUNTSMAN, National Marine Fisheries Service. An analysis of the Atlantic menhaden, *Brevoortia tyrannus*, (Pisces: Clupeidae) purse-seine fishery, 1955-69.
- 4:44 29. NICK C. PARKER AND BILL A. SIMCO, Memphis State University. A recirculating system for culture of channel catfish, *Ictalurus punctatus*.

PLANT PHYSIOLOGY, SESSION I

Regulation of Plant Responses:

Building 252, Room A

Presiding: Max Vines, University of Georgia

- 1:00 30. J. I. BARBER AND J. K. LEVINGSTON, Tulane University. The histones of *Lemna*: Changes observed under flowering conditions.
- 1:15 31. P. J. THOMPSON *, A. H. HABER, AND L. L. TRIPLETT, University of Tennessee and Oak Ridge National Laboratory. DNA synthesis and the phototransformation of etioplasts into chloroplasts.
- 1:30 32. R. D. POWELL, Texas A & M University. Studies on the opening of the hypocotyl hook.
- 1:45 33. J. H. YOPP, Southern Illinois University. Photomorphogenesis of the dentaria petiole hook.
- 2:00 34. G. C. COLCLASURE *, Southern Illinois University. Phenolic replacement of light requirement in 2 photomorphogenic systems.
- 2:15 35. E. H. BIRNBAUM * AND R. C. FITES, North Carolina State University. Effects of low temperature and light on isocitratase and isocitrate dehydrogenase levels during tobacco seed germination.
- 2:30 36. G. H. EGGLEY, USDA, Southern Weed Science Laboratory. Germination variability of common purslane (*Portulaca oleracea* L.) seed.
- 2:45 37. W. E. NORRIS, JR. AND M. N. WILEY, Southwest Texas State University. The effect of centrifugation of oat seeds on seedling development.
- 3:00 Coffee Break
- 3:15 38. J. E. FUCIK, Texas A & I University Citrus Center. Response of young citrus trees to an imposed magnetic field.
- 3:30 39. R. H. SMITH AND T. MURASHIGE, Texas A & M University and University of California at Riverside. Effects of foliar appendages and hormones on *Coleum blumei* apical meristems.
- 3:45 40. C. A. HOLLIS, University of Florida. An autoradiographic analysis of IAA transport in intact shoots of *Fraxinus americana* L.
- 4:00 41. Z. S. WOCHOK, University of Alabama. Auxin transport in *Selaginella willdenovii*.
- 4:15 42. W. R. GORDON * AND J. H. M. HENDERSON, Tuskegee Institute. Isoperoxidases of IAA in oat coleoptiles.
- 4:30 43. P. HOWLAND AND I. M. SUSSEX, Oak Ridge National Laboratory and Yale University. Wound regeneration, auxin and peroxidases in tobacco.

* Graduate Award Contestant.

PLANT PHYSIOLOGY, SESSION II

Photosynthesis, Photorespiration and Phytochrome

Building 252, Room B

Presiding: George Fritz, University of Florida

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| 1:00 | 44. S. O. DUKE * AND A. W. NAYLOR, Duke University. Some effects of light and feeding precursors on anthocyanin biosynthesis in dark-grown <i>Zea mays</i> L. | 2:45 | 51. A. LAUCHLI, Texas A & M University. Transport of photosynthates to the phloem of cotton leaves: Kinetics of ¹⁴ C-incorporation into the photosynthetic products. |
| 1:15 | 45. L. H. PRATT AND R. A. COLEMAN, Vanderbilt University. Visualization of phytochrome with the electron microscope. | 3:00 | Coffee Break |
| 1:30 | 46. S. C. CUNDIFF * AND L. H. PRATT, Vanderbilt University. Immunochemistry of phytochrome. | 3:15 | 52. T. L. HOUSLEY * AND D. B. FISHER, University of Georgia. The absolute efficiency of ¹⁴ C detection by high-resolution microautoradiography. |
| 1:45 | 47. B. ROARK AND J. E. QUISENBERRY, USDA and the Texas Agricultural Experiment Station. Studies on stomatal frequency and distribution in <i>Gossypium hirsutum</i> L. I. Cultivars developed on the Texas High Plains. | 3:30 | 53. R. S. ALBERTE *, J. P. THORNBUR AND A. W. NAYLOR, Duke University and University of California at Los Angeles. Time of appearance of photosystems I and II in chloroplasts of greening jack bean leaves. |
| 2:00 | 48. C. M. WILLMER AND J. E. PALLAS, JR., USDA and the University of Georgia. Stomatal movements and associated potassium fluxes in the plant kingdom. | 3:45 | 54. I. ROUHANI *, H. M. VINES AND C. C. BLACK, University of Georgia. Isolation of intact mesophyll cells from a Crassulacean acid metabolism (CAM) plant <i>Sedum telephium</i> . |
| 2:15 | 49. J. E. PALLAS, JR., USDA and the University of Georgia. Organic acid changes in the epidermis of <i>Vicia faba</i> as related to stomatal opening. | 4:00 | 55. T. WHELAN, W. M. SACKETT, AND C. R. BENEDICT, Texas A & M University. The enzymatic isotope effect associated with PEP carboxylase. |
| 2:30 | 50. Y. B. SAMISH AND J. E. PALLAS, JR., USDA and the University of Georgia. Selection techniques for determining high photosynthetic efficiency as deduced from the gas exchange of oats and soybeans. | 4:15 | 56. T. WHELAN, W. M. SACKETT AND C. R. BENEDICT, Texas A & M University. Carbon isotope fractionation in <i>Chromolaena</i> . |
| | | 4:30 | 57. R. H. BROWN, University of Georgia. The post-illumination CO ₂ burst in C ₄ grasses. |

PLANT PHYSIOLOGY, SESSION III

General Plant Physiology

Building 252, Room C

Presiding: Fred T. Wolf, Vanderbilt University

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| 2:00 | 58. DANIEL D. JONES AND D. JAMES MORRE', University of Alabama in Birmingham and Purdue University. Effect of exogenous sugars on polysaccharide secretion in outer root-cap cells of <i>Zea mays</i> . Monocotyledoneae, Poales, Poaceae. | 2:45 | 61. EDWIN H. CROWDER AND WILLIAM H. DARDEN, Jefferson State Junior College and University of Alabama. Studies of calf thymus histone in male induction in <i>Volvox aureus</i> M5. |
| 2:15 | 59. JAMES P. BARNETT, USDA Southern Forest Experiment Station. Innate dormancy in southern pine seeds. | 3:00 | 62. WILLIAM B. GURLEY AND CHARLES E. ANDERSON, North Carolina State University. Lignification as related to salinity in <i>Salicornia virginica</i> L. (Dicotyledonae: Chenopodiales: Chenopodiaceae) |
| 2:30 | 60. JAMES D. CAPONETTI, The University of Tennessee. Protein patterns in the shoot apical region and the leaf sets of <i>Osmunda cinnamomea</i> L. (Pteropsida, Osmundales, Osmundaceae) | 3:15 | 63. PREM P. SHIGAI, CLAUDE L. HUGHES, AND THOMAS M. VICARS, East Carolina University. Chlorophyll production in mustard seedlings Cruciferae — <i>Brassica nigra</i> . |
| | | 3:30 | Coffee Break |

* Graduate Award Contestant.

- 3:45 64. LINDA E. OVERHOLSER AND T. K. SCOTT, University of North Carolina. Culture of pea seedling explants and the problem of apical dominance.
- 4:00 65. KATHRYN L. EDWARDS AND T. K. SCOTT, University of North Carolina. Fast growth responses in the primary root of *Zea mays*.
- 4:15 66. ROBERT G. TUCKER AND W. H. DARDEN, Troy State University and University of Alabama. The effect of selected anti-metabolites on development in *Volvox aureus* (Volvocaceae).
- 4:30 67. WILLIAM H. DARDEN, JR., University of Alabama. Specificity of a phenol extract from *Volvox* (Volvocaceae) in male induction.

FRIDAY MORNING - APRIL 7

AQUATIC ECOLOGY, SESSION I

Building 170, Room B

Presiding: Dr. Kenneth L. Dickson, Virginia Polytechnic Institute and State University

- 8:30 68. ALBERT HENDRICKS AND FRED BENFIELD, Virginia Polytechnic Institute and State University. Preliminary results of eutrophication studies on Smith Mountain Lake.
- 8:44 69. EDWIN E. HERRICKS AND JOHN CAIRNS, JR., Virginia Polytechnic Institute and State University. The recovery of stream macrobenthic communities from the effects of acid mine drainage.
- 8:58 70. L. M. OUTTEN, Mars Hill College. Limnological studies of a southeastern stream.
- 9:11 71. ERNEST F. BENFIELD, ALBERT C. HENDRICKS AND JOHN CAIRNS, JR., Virginia Polytechnic Institute and State University. The suitability of two types of artificial substrates in assessing the impact of an industrial effluent on stream macrobenthic community structure.
- 9:25 72. LOUIS G. WILLIAMS, University of Alabama. Cycling of mercury and other heavy metals in the Black Warrior River.
- 9:51 73. E. E. JONES, University of South Alabama. The role of certain protozoa in Mobile Bay.
- 10:04 74. GAIL SULLIVAN AND ARTHUR L. BUIKEMA, JR., Virginia Polytechnic Institute and State University. The effect of hardness on the toxicity of zinc sulfate to the rotifer.
- 10:18 75. J. FRANK MCCORMICK, University of North Carolina. An ecological analysis of energy demands and resources.
- 10:32 76. JERRY C. RITCHIE, J. ROGER MCHENRY, AND ANGELA C. GILL, U. S. Sedimentation Laboratory. Dating recent reservoir sediment using radioactive fallout.

ANIMAL ECOLOGY, SESSION II

Building 170, Room A

Presiding: Dr. James L. Wolfe, Mississippi State University

- 8:15 77. SNEED B. COLLARD, University of West Florida. Notes on the natural history of *Idotea metallica* (Isopoda: Idoteidae) from the eastern Mediterranean.
- 8:29 78. SYED M. NAQVI AND ARMONDO A. DE LA CRUZ, Mississippi State University. Effects of Mirex insecticide on selected freshwater invertebrates.
- 8:43 79. STUART S. BAMFORTH, Newcomb College of Tulane University. Principles of soil protozoogeography.
- 8:57 80. DEE S. DUNDEE, Louisiana State University in New Orleans. Introduced land molluscs of the United States.
- 9:11 81. COURTNEY T. HACKNEY AND OLGA P. HACKNEY, Emory University. Animal changes in the population size structure of *Penaeus setiferus* (Crustacea, Decapoda, Penaeidae).
- 9:25 Coffee Break
- 9:35 82. PATRICK R. PARRISH, JACK I. LOWE, ALFRED J. WILSON, JR., AND JAMES M. PATRICK, JR., Environmental Protection Agency, Associate Laboratory of the National Environmental Research Center. Effects of Aroclor ¹²⁵⁴, a PCB, on oysters, *Crassostrea virginica* (Bivalvia: Protobranchia: Ostreidae).

- 9:49 83. B. J. KELLEY, JR., AND W. D. BURBANCK, Emory University. Effects of salinity and ionizing gamma irradiation on the developmental stages of *Cyathura polita* (Stimpson), (Crustacea: Isopoda: Anthuridae).
- 10:03 84. CHARLES N. BOEHMS AND CHARLES E. JENNER, Austin Peay State University and University of North Carolina at Chapel Hill. The influence of temperature upon embryonic diapause and seasonal regulation in *Sympetrum vicinum* (Hagan) (Odonata: Libellulinae).
- 10:17 85. JOHN S. CROSSMAN AND JOHN CAIRNS, JR., Virginia Polytechnic Institute and State University. A comparison of two macro-invertebrate samplers and regular stream sampling techniques.
- 10:31 86. JOHN S. CROSSMAN, JERRY C. SMRCHEK AND JOHN CAIRNS, JR., Virginia Polytechnic Institute and State University. A preliminary study of the pelecypoda in the upper Clinch River.

ANIMAL PHYSIOLOGY, SESSION I

Building 170, Room C

Presiding: Dr. James Yarbrough, Mississippi State University

- 8:00 87. LARRY J. TILLMAN AND IOLA T. MCCLURKIN, University of Mississippi. A histological study of the structural adaptation of medullary nephrons in *Gallus domesticus* for a potential counter-current mechanism.
- 8:14 88. MARILYN A. COLEMAN AND ALAN G. HEATH, Virginia Polytechnic Institute and State University. A new method for monitoring respiration rate in crayfish *Crustacea Decapoda*, *Cambarus bartonii* and *Procambarus clarkii*.
- 8:28 89. ARTHUR L. BUIKEMA, JR., KIRK K. SHY AND SALLY A. HALLGREN, Virginia Polytechnic Institute and State University and St. Olaf College. The effect of temperature on metabolic rate, thyroid morphology and blood glucose levels.
- 8:42 90. DONALD E. HOSS AND CURTIS W. LEWIS, National Marine Fisheries Service. Excretion rate of ^{65}Zn by the pinfish (*Lagodon rhomboides*) in relation to metabolism.
- 8:56 91. LEWIS P. STRATTON, ANN S. PAGET AND J. EDWARD BROWN, Furman University. Biochemical studies of environmental temperature effects on *Micropterus salmoides*.
- 9:10 92. JOSEPH F. WITZEL, JR. AND HONG S. MIN, Georgia Institute of Technology. Preinduction activity of the inducible malic enzyme of *Streptococcus faecalis*.
- 9:23 Coffee Break
- 9:35 93. MAHENDRA K. MOHANTY, FRISSELL R. HUNTER, AND JOSEPH B. MYERS, Atlanta University and Savannah State College. NAD and NADPH oxidase systems in *Englena gracilis* var. *bacillaris*.
- 9:49 94. ANITA F. DYE AND B. G. MOORE, University of Alabama. Spermine as a stimulator of *Escherichia coli* tRNA methylases.
- 10:03 95. JOSEPH B. MYERS, Atlanta University. Fine structure of an insect myocardium.
- 10:17 96. J. G. GEIGER AND R. R. MILLS, Virginia Commonwealth University. Haemocyte function during ecdysis by the american cockroach *Periplaneta americana* (L.).
- 10:31 97. DONALD J. BARRAS, R. L. KISNER AND W. J. LEWIS, Troy State University. Effects of the parasitoid, *Microplitis croceipes* on the hemolymph proteins of *Heliothis zea*.

CRYPTOGAMIC BOTANY, SESSION I

Building 171, Room C

Presiding: Dr. Temd R. Deason, University of Alabama

- 8:30 98. WILLEM G. COOLS AND MILTON C. RUSH, Louisiana State University. The water-mold disease of rice in Louisiana.
- 8:44 99. CHARLES E. BLAND AND HENRY V. AMERSON, East Carolina University. Observations on *Lagenidium callinectes* Couch: isolation and development (Oomycetes, Lagenidiales).
- 8:58 100. HENRY V. AMERSON AND CHARLES E. BLAND, East Carolina University. Fine structure of spore development in *Lagenidium callinectes* Couch (Oomycetes, Lagenidiales).
- 9:12 101. JAMES L. HARRIS AND WILLARD A. FABER, Texas A & M University. Morphogenesis and fine structure of the synnema of the ascomycete *Ceratocystis ulmi*.

- 9:25 Coffee Break
- 9:35 102. HAROLD F. MABEE, East Tennessee State University. Seasonal variations of soil fungi demonstrated by the strip bait method.
- 9:49 103. JOHN CLAUSZ, St. Andrews Presbyterian College. Location and periods of water mold activity in a lake.
- 10:03 104. RICHARD T. HANLIN, University of Georgia.
- 10:17 105. LEVESTER PENDERGRASS AND LAFAYETTE FREDERICK, Atlanta University. Myxomycetes from bark of living trees in Panola Mountain State Park.
- 10:31 106. ROBERT O. BLANCHARD, University of Georgia. Light and electron microscopic observations of host-parasite relationships in southern corn leaf blight.

DEVELOPMENTAL BIOLOGY AND ANATOMY

Building 168, Room A

Presiding: Dr. E. E. Jones, University of South Alabama

- 8:30 107. JOHN M. BROWNE, Atlanta University. Osmotic pressure changes in cerebrospinal fluid and their relation to morphogenesis of the chick brain.
- 8:44 108. H. KEITH BROWN AND GEORGE R. BERNARD, Medical College of Georgia. An unusual gland in the opossum.
- 8:58 109. WILLIE M. REAMS, JR. AND ALBERT J. BANES, University of Richmond and Medical College of Virginia. Epidermal morphogenesis on dead dermis.
- 9:12 110. BILL P. LOVEJOY, Georgia Southern College. Postnatal development, growth and behavior of a primitive rodent, *Aplodontia rufa*.
- 9:26 111. FREDERICK W. HARRISON, NORIMITSU WATABE, AND RICHARD M. DILLAMAN, Presbyterian College and University of South Carolina. Histochemistry and preliminary electron microscopy of early gemmule development (Porifera: Spongillidae).
- 9:40 112. NANCY C. EDWARDS, University of North Carolina at Charlotte. Synthetic activity following a light stimulus in oocytes of a marine hydroid.

ICHTHYOLOGY AND HERPETOLOGY, SESSION II

Building 171, Room A

Presiding: Dr. Robert Mount, Auburn University

- 8:15 113. MARGARET B. HOWELL AND CRAWFORD G. JACKSON, JR., Mississippi State College for Women. Preliminary studies on size relationships of the propodial elements of turtles (Reptilia: Testudines).
- 8:29 114. CRAWFORD G. JACKSON, JR., CHARLIE M. HOLCOMB, MARGUERITE M. JACKSON, AND SKAIDRITE KLEINBERGS, Mississippi State College for Women and San Diego State College. Geographic variation in ⁹⁰Sr body burdens of southeastern turtles.
- 8:43 115. BETTY L. QUONG, CRAWFORD G. JACKSON, JR., AND MARGUERITE M. JACKSON, Mississippi State College for Women. A preliminary investigation of the intestinal tract dimensions of turtles (Reptil Testudines).
- 8:57 116. BARBARA A. FISCHER, University of Southern Mississippi. Comparative underwater survival of seven species of Mississippi turtles (Order Chelonia, Class Reptilia).
- 9:11 117. GEORGE M. POLLARD, CHARLES J. BIGGERS AND MICHAEL J. HARVEY, Memphis State University. Electrophoretic differentiation of the parotid venoms of *Bufo americanus americanus* and *Bufo woodhousei fowleri* (Amphibia, Anura, Bufonidae).
- 9:25 Coffee Break
- 9:35 118. MICHAEL W. DIX, T. R. DIX AND M. R. LOOMIS, University of Georgia. Salivary enzymes of some colubrid and crotalid snake species (Reptilia, Squamata).
- 9:49 119. RONALD ALTIG, Mississippi State University. Morphological and pigmentary characters of F₁ Hybrid Tadpoles between species of *Pseudacris* (Hylidae, Anura).
- 10:03 120. JON R. FORTMAN AND RONALD ALTIG, Mississippi State University. Characters of F₁ hybrid frogs between six species of *Hyla*.
- 10:17 121. MICHAEL S. LOOP AND LAWRENCE G. BAILEY, Florida State University. The effect of relative prey size on the ingestion behavior of rodent eating snakes: *Boidae*, *Colubridae*, and *Viperidae*.
- 10:31 122. MICHAEL S. LOOP, Florida State University. Twilight movement patterns of some Florida snakes and potential predators.

ICHTHYOLOGY AND HERPETOLOGY, SESSION III

Building 170, Room D

Presiding: Dr. Fred Hemphill, Spring Hill College

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| 8:00 | 123. | HECTOR HARIMA AND HERBERT T. BOSCHUNG, JR., University of Alabama. A report on the Ichthyofauna of the Amazon River at Puerto Nariño, Colombia. | 9:24 | | Coffee Break |
| 8:14 | 124. | EUGENE C. BECKHAM, III AND HERBERT T. BOSCHUNG, JR., University of Alabama. Members of the Order Siluriformes collected in the Amazon River at Puerto Nariño, Colombia. | 9:35 | 129. | ROBERT A. KUEHNE, University of Kentucky. Appearance and Distribution of the named and unnamed snubnose darters (<i>Ulocentra</i>), <i>Etheostoma</i> , Percidae, Osteichthyes). |
| 8:28 | 125. | GLENN H. CLEMMER AND DAVID C. HEINS, Mississippi State University. Fishes of the Jourdan River System in southern Mississippi. | 9:49 | 130. | DAVID A. ETNIER, University of Tennessee. Current status of several rare and/or endangered species of Tennessee fishes. |
| 8:42 | 126. | THOMAS S. JANDEBEUR AND HERBERT T. BOSCHUNG, University of Alabama. A study of the fishes of the Elk River drainage system in Alabama and Tennessee. | 10:03 | 131. | ROBERT A. STILES, University of Tennessee. The reproductive behavior of three species of darters (<i>Etheostoma</i>) of the subgenus <i>Nothonotus</i> . (Osteichthyes, Perciformes, Percidae). |
| 8:56 | 127. | JAMES D. WILLIAMS, Mississippi State College for Women. A new cottid fish from the Tallapoosa River with a review of the <i>Cottus caroliniae</i> species group in the Mobile Basin. | 10:17 | 132. | DAVID C. HEINS AND GLENN H. CLEMMER, Mississippi State University. The reproductive biology of the longnose shiner, <i>Notropis longirostris</i> (Cyprinidae), in Mississippi. |
| 9:10 | 128. | RAYMOND WILLIAM BOUCHARD, University of Tennessee. A new darter of the subgenus <i>Ulocentra</i> from the Caney Fork River System in Tennessee (Osteichthyes, Perciformes, Percidae). | 10:31 | 133. | MARGO SCHNEEBALG STAHL AND WON TACK YANG, University of Miami Rosenstiel School of Marine and Atmospheric Sciences. Laboratory spawning and development of <i>Lophogobius cyprinoides</i> (Pallas). |

PARASITOLOGY, SESSION I

Building 171, Room D

Presiding: Dr. Donald Barras, Troy State University

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| 8:15 | 134. | J. FRED DENTON AND WAYNE A. KRIS-SINGER, Medical College of Georgia. Life cycle patterns in the Leiptrematinae (Trematoda: Dicrocoeliidae). | | | gia. Comparison of <i>Brugia pahangi</i> infections in Mongolian Jirds (<i>Meriones unguiculatus</i>) following intraperitoneal and subcutaneous injections. |
| 8:29 | 135. | WAYNE A. KRISINGER AND J. FRED DENTON, Medical College of Georgia. Observations on the life history of <i>Lutztrema monenteron</i> . | 9:25 | | Coffee Break |
| 8:43 | 136. | HYONG-SUN AH, PAUL E. THOMPSON, FRANK E. MITCHELL, AND JOHN C. PECKHAM, College of Veterinary Medicine, University of Georgia. Immunization of dogs with gamma-irradiated infective larvae of a zoonotic filarial worm, <i>Brugia pahangi</i> . | 9:35 | 139. | THOMAS R. KELL, University of Georgia. Fine structure of <i>Haemoproteus columbae</i> sporozoites. |
| 8:57 | 137. | J. B. MALONE, J. W. MCCALL, W. L. CHAPMAN, JR., H. S. AH, AND P. E. THOMPSON, University of Georgia. Effects of total body X-irradiation and route of inoculation on susceptibility and hematologic response of Mongolian Jirds (<i>Meriones unguiculatus</i>) to <i>Brugia pahangi</i> . | 9:49 | 141. | VERNON N. POWDERS, Georgia Southwestern College. Seasonal studies of parasites on the cattle egret, <i>Bubulcus ibis</i> , by the nasal mite, <i>Neonyssus</i> (Acarina: Rhinonyssidae), and the hypophial nymph, <i>hypodectes</i> (Acarina: Hypoderidae). |
| 9:11 | 138. | J. W. MCCALL, H. S. AH, J. B. MALONE, AND P. E. THOMPSON, University of Georgia. | 10:03 | 142. | CHARLES A. JOHNSON, III, Duke University Marine Laboratory. A preliminary report on diseases of North Carolina coastal crabs with emphasis on the blue crab, <i>Callinectes sapidus</i> . |
| | | | 10:17 | 143. | E. E. BYRD AND S. R. PURSGLOVE, JR. Some strigate trematodes from the American woodcock, <i>Philohela minor</i> (Gmelin). |

PLANT ECOLOGY, SESSION I

Building 252, Room C

Presiding: Dr. John Witherspoon, Oak Ridge National Laboratory

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| <p>8:00 144. H. J. WINFREY AND G. L. SAMSEL, Virginia Commonwealth University. Preliminary effects on algal succession resulting from nutrient enrichment of two central Virginia ponds with different trophic states.</p> <p>8:14 145. TOM E. GREENE, MARGARET MILLER, ARTHUR R. GARRETT, University of South Alabama. Preliminary investigations of ecosystem dynamics in the Dog River.</p> <p>8:28 146. BRIAN J. ARMITAGE, GEORGE M. SIMMONS, JR. AND JOHN C. WHITE, JR., Virginia Polytechnic Institute and State University, and Virginia Electric and Power Company. An evaluation of a heated discharge on phytoplankton blooms in the Potomac River Estuary.</p> <p>8:42 147. TAYLOR R. ALEXANDER, University of Miami. Ecology of tree island margins in the Florida southeastern Everglades.</p> <p>8:56 148. RICHARD GEIGER, Savannah River Ecology Laboratory. Cesium contamination of a fresh water creek and its floodplain.</p> <p>9:10 149. JOEL H. BRASWELL AND G. L. PLUMMER, University of Georgia. An analysis of</p> | <p>land use patterns of Georgia uplands using species diversity methodology: A new approach in plant geography.</p> <p>9:24 Coffee Break</p> <p>9:35 150. H. R. DESELM, C. C. AMOUNSDEN, P. F. KRUMPE AND T. W. TAYLOR, The University of Tennessee. Inferences from remote sensing of forest landscapes.</p> <p>9:49 151. JERRY M. BASKIN AND CAROL C. BASKIN, University of Kentucky. The light factor in the germination ecology of <i>Draba verna</i> L.</p> <p>10:03 152. LINDA M. STROUD, North Carolina State University. Further studies on prediction of stem weight from stem height in <i>Spartina alterniflora</i>.</p> <p>10:17 153. F. G. TAYLOR, JR., Oak Ridge National Laboratory. Role of phenology to production in forest understory vegetation.</p> <p>10:31 154. JOHN DUV. HAY, H. L. RAGSDALE, AND DONALD J. SHURE, Emory University. Dynamics of diamorpha systems on granite outcrops.</p> |
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PLANT PHYSIOLOGY, SESSION IV

Water and Mineral Utilization, and Translocation

Building 252, Room A

Presiding: Dr. Donald Fisher, University of Georgia

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| <p>8:00 155. C. S. MILLER, Texas A & M University. The influence of soil moisture on short-interval leaf movements.</p> <p>8:15 156. E. L. FISCUS, Duke University. Water potential measurement of intact roots.</p> <p>8:30 157. S. B. FOX * AND R. C. SMITH, University of Florida. Apparent free space in excised segments from different regions of the corn root.</p> <p>8:45 158. R. J. NEWTON *, Texas A & M University. Dual pattern of DL-leucine-1-¹⁴C absorption by root tips of <i>Lemma minor</i> L.</p> <p>9:00 159. E. MICHEL, University of Georgia. Sucrose solution solute potentials.</p> <p>9:15 160. M. L. CHRISTENSEN * AND C. S. MILLER, Texas A & M University. Measurements of phloem transport velocity in cotton.</p> | <p>9:30 161. L. R. PARSONS * AND P. J. KRAMER, Duke University. Resistances to water flow through <i>Nicotiana tabacum</i> L.</p> <p>9:45 162. V. E. BECKER AND R. O. DONALD, Wake Forest University. Uptake and translocation of the alkali metal ions by rye plants.</p> <p>10:00 Coffee Break</p> <p>10:15 163. G. C. COLCLASURE * AND W. E. SCHMID, Southern Illinois University. Absorption of cobalt by excised barley roots.</p> <p>10:30 164. H. E. JOHAM, Texas A & M University. The tissue concentration of zinc in relation to growth, fruiting and the resistance of cotton to verticillium wilt.</p> <p>10:45 165. R. A. STANLEY AND C. GOODE, Tennessee Valley Authority. Mineral nutrition of a submersed macrophyte.</p> |
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* Graduate Award Contestant.

11:00 166. P. W. MORGAN AND J. I. DURHAM, Texas A & M University. Auxin-transport inhibitors as promoting agents for leaf abscission.

11:15 167. H. R. MILLER * AND M. C. CARTER, Au-

burn University. Response of young loblolly pine to foliar applications of urea.

11:30 168. L. P. BUSH, B. DICKERSON AND J. L. SIMS, University of Kentucky. Influence of maleic hydrazide on dry weight distribution in tobacco plants.

PLANT PHYSIOLOGY, SESSION V

Biosynthesis, Protein Patterns, and Enzymes

Building 252, Room B

Presiding: Dr. Thomas Humphreys, University of Florida

8:00 169. O. J. SCHWARZ AND A. H. HABER, University of Tennessee and Oak Ridge National Laboratory. Thymidine phosphorylation in wheat.

8:15 170. B. C. MULLIN * AND R. C. FITES, North Carolina State University. Aspects of thymidine metabolism in germinating peanut axes.

8:30 171. C. GRUNWALD AND P. B. BUSH, University of Kentucky. Steryl glycoside synthetase in tobacco seedlings.

8:45 172. E. B. JOHNS *, North Carolina State University. Lipxygenase mediated pentane production.

9:00 173. J. I. DURHAM, P. W. MORGAN, C. M. LYMAN AND J. M. PRESCOTT, Texas A & M University. Ethylene synthesis in peanut embryos.

9:15 174. E. W. SMITH * AND R. C. FITES, North Carolina State University. Low temperature alteration of isocitratase levels and sedimentation characteristics of organelles from germinating cotton seedlings.

9:30 175. M. N. SEARS, Duke University. The purification and properties of arginase from *Canavalia ensiformis* (L.) DC seeds.

9:45 176. A. F. BAKER AND R. W. HOLTON, Chico

State College and University of Tennessee. Malic dehydrogenase isozyme patterns in nine isolates of oscillatorian blue-green algae.

10:00 Coffee Break

10:15 177. D. L. THOMAS, N. J. NEUCERE, J. E. BRIGHT, AND J. J. KOKEMOR, Louisiana State University in New Orleans. Thermostability of enzymes and total proteins of peanuts: *in situ* (dormant and 5-day) and *in vitro* (dormant); electrophoresis.

10:30 178. EDWARD KIRBY, University of Florida. An autoradiographic study of fucose and glucosamine incorporation into plant cells.

10:45 179. JACK W. CARROLL, R. E. DANIEL AND J. C. O'KELLEY, University of Alabama. Relationship of nucleic acid and protein synthesis to zoospore formation in *Protosiphon botryoides* Klebs. Chlorophyceae, Chlorococcales, Protosiphonaceae.

11:00 180. ROBERT A. MOORE, FRISSELL R. HUNTER, AND JOSEPH B. MYERS, Atlanta University and Savannah State College. NADH diaphonase in *Euglena gracilis* strain Z.

11:15 181. JERRY P. THOMAS, GARY L. BUTLER AND JOSEPH C. O'KELLEY, University of Alabama. Isolation and characterization of protein pigments absorbing at wavelengths which regulate cell division in a photosynthesizing organism, *Protosiphon botryoides* (Chlorophyceae, Chlorococcales, Protosiphonaceae).

* Graduate Award Contestant.

PLANT TAXONOMY, SESSION I

Building 171, Room B

Presiding: Dr. J. Ray Watson, Mississippi State University

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| <p>8:30 182. MILES F. JOHNSON, Virginia Commonwealth University. Floristics of <i>Eupatoriadelphus</i> King and Robinson and <i>Ageratina</i> Spach (Eupatoriaceae-Asteraceae) in Virginia.</p> <p>8:44 183. RONALD W. PEARMAN, University of Tennessee. A scanning electron microscopic investigation of the spores of the fern genus <i>Cystopteris</i> Bernh. (Pteropsida: Filicales: Aspidiaceae).</p> <p>8:58 184. MARY-GRACE CURRY, Louisiana State University. Notes on the foliar indument of <i>Elephantopus</i> L. (Compositae) in Louisiana.</p> <p>9:12 185. CHARLES M. ALLEN, Louisiana State University. A preliminary survey of the vascular flora of St. Helena Parish, Louisiana.</p> <p>9:25 186. EARL S. PARKER. Systematic studies of</p> | <p>the genus <i>Balduina</i> (Compositae).</p> <p>9:39 Coffee Break</p> <p>9:50 187. RUSSELL L. KOLOGISKI, North Carolina State University. <i>Dinebra retroflexa</i> (Vahl) Panzer (Gramineae), a genus and species new to the United States.</p> <p>10:04 188. CHARLES H. PERINO, North Carolina State University. Systematics of <i>Chaetopappa</i> series <i>Effusae</i> (Compositae-Astereae).</p> <p>10:18 189. GENE S. VAN HORN, University of Tennessee at Chattanooga. Dissociation of <i>Pentachaeta</i> from <i>Chaetopappa</i> (Asteraceae: Astereae).</p> <p>10:32 190. JOHN RUFFIN, Atlanta University. Morphology and anatomy of the genera <i>Amphipappus</i>, <i>Amphiachyris</i>, <i>Greenella</i>, <i>Gutierrezia</i>, <i>Gymnosperma</i>, <i>Xanthocephalum</i> and <i>Thurovia</i> (Compositae).</p> |
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FRIDAY AFTERNOON - APRIL 7

AQUATIC ECOLOGY, SESSION II

Building 170, Room B

Presiding: Dr. Gerald Moshiri, University of West Florida

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| <p>1:30 191. G. L. SAMSEL, H. J. WINFREY, J. R. REED, F. B. BLOOD, Virginia Commonwealth University. Investigations on nutrient factors limiting phytoplankton productivity in two central Virginia ponds.</p> <p>1:41 192. LUTHER A. KNIGHT, JR., University of Mississippi. Limnological studies on Ross Barnett Reservoir, a shallow water reservoir.</p> <p>1:58 193. R. P. HANNAH, G. A. MOSHIRI, AND A. T. SIMMONS, The University of West Florida. Effects of a nutrient-enriched stream on phytoplankton carbon fixation in a bayou estuary.</p> <p>2:12 194. A. T. SIMMONS, G. A. MOSHIRI, AND R. P. HANNAH, The University of West Florida. Dynamics of nitrogen and phosphorus inputs in a bayou estuary.</p> <p>2:26 195. F. BLOOD, J. WINFREY, J. REED, G. SAMSEL, Virginia Commonwealth University. Preliminary comparison of two oxidation ponds with different trophic states in central Virginia.</p> | <p>2:40 Coffee Break</p> <p>2:50 196. ALBERT L. TATE, Emory University. Effects of a natural draft cooling tower on the local environment.</p> <p>3:04 197. MICHAEL W. ROBERTS, Mississippi State University. A preliminary appraisal of wildlife habitat provided by cottonwood (<i>Populus deltoides</i>) plantations in the Mississippi delta.</p> <p>3:18 198. ARMANDO A. DE LA CRUZ, Mississippi State University. Organic content of waters and sediments in four aquatic habitats in Mississippi.</p> <p>3:32 199. D. L. FICK, G. C. LLEWELLYN, G. L. SAMSEL, Virginia Commonwealth University. Effects of radiation and oxygen stress on an aquatic microecosystem.</p> <p>3:46 200. FRANK A. CAMP, E. F. BENFIELD, ALBERT C. HENDRICKS, Virginia Polytechnic Institute and State University. Analyses of zinc levels in bottom samples and aquatic macroinvertebrates from a river receiving a zinc-rich industrial effluent.</p> |
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ANIMAL ECOLOGY, SESSION III

Building 170, Room A

Presiding: Dr. Richard M. Johnson, University of South Alabama

- 1:15 201. GORDON W. THAYER AND SCOTT RICE, National Marine Fisheries Service and West Carteret High School. Effects of increased temperature on the survival of zooplankton. *stoma spectabile* (Agassiz) in a small Kentucky stream.
- 1:29 202. JAMES B. SICKEL, Emory University. Precautions in using population structure of freshwater mussels as an indicator of river pollution (Pelecypoda: Schizodonta: Unionidae).
- 1:43 203. NELSON R. COOLEY AND JAMES M. KELTNER, JR., Environmental Protection Agency, Associate Laboratory of the National Environmental Research Center. Effect of Aroclor[®] 1248, a polychlorinated biphenyl, on growth of populations of *Tetrahymena pyriformis* W (Ciliata; Hymenostomatida; Hymenostomatidae).
- 1:57 204. LINDA A. BRIESE AND DR. MICHAEL SMITH, Savannah River Ecology Laboratory. Terrestrial activity of two species of *Bufo*.
- 2:11 205. HARVEY L. STIREWALT, Augusta College and the University of Tennessee. Effects of dredging on fishes and macroinvertebrate populations.
- 2:25 206. JAMES H. WILSON, ALBERT C. HENDRICKS, KENNETH L. DICKSON, AND JOHN CAIRNS, JR., Virginia Polytechnic Institute and State University. An example of the use of preconstruction ecological surveys in regional planning.
- 2:39 207. J. D. DAVIS, V. S. CAIN, J. R. DAVIS, R. C. DEATON, L. GREEN AND W. A. LEWIS, JR., Mississippi State College for Women. A quantitative study of wingflashing by the eastern mockingbird, *Mimus polyglottus* in two agonistic contexts.
- 2:52 Coffee Break
- 3:05 208. JAMES W. SMALL, JR., University of Kentucky. Bioenergetics of the darter *Etheostoma spectabile* (Agassiz) in a small Kentucky stream.
- 3:19 209. ERIC L. MORGAN, JOHN CAIRNS, JR., AND RICHARD E. SPARKS, Virginia Polytechnic Institute and State University. Response of Fish in a Pollution Monitoring System.
- 3:33 210. THOMAS E. LODGE, University of Miami. Hemoglobin Phenotypes in Populations of the Yellow Bullhead (Osteichthyes, Siluriformes, Ictaluridae, *Ictalurus natalis* (Lesueur)).
- 3:47 211. DENNIS T. BURTON, Academy of Natural Sciences of Philadelphia, ERIC L. MORGAN AND JOHN CAIRNS, JR., Virginia Polytechnic Institute and State University. The Effect of Increasing Temperatures on Mortality Rates of Bluegills (*Lepomis macrochirus* Raf.) Exposed to a Toxic Concentration of Zinc.
- 4:01 212. DONALD E. SCOTT, University of West Florida. Host-parasite Relationships: Metazoan Ectoparasites of the Grey Mullet, *Mugil cephalus*.
- 4:15 213. ROBERT J. BEYERS, BARBARA J. BEYERS, AND MICHAEL H. SMITH, Savannah River Ecology Laboratory. Morphometric Measurements, Body Composition, and Elemental Content of Small Florida Fish.
- 4:29 214. I. LEHR BRISBIN, BARBARA, BEAMON, MARK L. BONTECOU, AND RICHARD A. GEIGER, Savannah River Ecology Laboratory. Preliminary Studies of ¹³⁷Cs Radio-nuclide Whole Body Burdens in Birds of the AEC Savannah River Plant.
- 4:43 215. JOHN B. GENTRY AND DOUGLAS M. CARLSON, Savannah River Ecology Laboratory, University of Georgia. Effects of Shading on the Migratory Behavior of the Migratory Behavior of the Florida Harvester Ant, *Pogonomyrmex badius* (Insecta: Hymenoptera: Formicidae).

ANIMAL PHYSIOLOGY, SESSION II

Building 170, Room C

Presiding: Dr. John P. MacNamara, Spring Hill College

- 1:00 216. G. C. LLEWELLYN, W. S. HASTINGS, T. D. KIMBROUGH, Virginia Commonwealth University. Dimethylformamide Toxicity and Pathology in *Meriones unguiculatus*.
- 1:14 217. TERRY N. TROBEC AND ALBERT H. MEIER, Louisiana State University. Photoperiodic and Thermoperiodic Entrainment of Daily Rhythms of Responses to Prolactin in the Lizard, *Anolis carolinensis* Reptilia Lacertilia.
- 1:28 218. KENNETH B. DAVIS, EDWARD SEGERSON, AND DONALD I. LEWIS, Memphis State University. Seasonal Differences in the Response of the Reproductive Tract of the Lizard, *Anolis carolinensis*, to Elevated Temperatures and Timed Injections of FSH.
- 1:42 219. BILL A. SIMCO, KENNETH B. DAVIS, AND CAROL PIERCE, Memphis State University. The Effect of Salinity on Plasma Na⁺, Cl⁻,

- Hematocrit, Total Solids and Total Proteins of *Ictalurus punctatus* (Teleostei: Ictaluridae).
- 1:56 220. MARION R. WELLS AND JAMES D. YARBROUGH, Middle Tennessee State University and Mississippi State University. Retention of ^{14}C -aldrin and ^{14}C -Dieldrin in cellular fractions of vertebrate insecticide-resistant and susceptible tissue.
- 2:10 221. DAN KIMBROUGH AND KAREN E. RAPP, Virginia Commonwealth University. The Effect of Pinealectomy on Intestinal Function in the Rat.
- 2:24 222. BARBARA A. BEAVER, DAN KIMBROUGH AND GERALD C. LLEWELLYN, Commonwealth University. The Platelet Count as Affected by Changes in Serotonin Levels in the Rat.
- 2:38 223. R. D. HOOD, University of Alabama. Alleviation of Arsenate Teratogenesis in Mice by Bal.
- 3:06 224. G. R. HOGAN, S. S. DAUL AND W. JONES, University of North Carolina at Charlotte. Erythropoietic Responses of Cholesterol-, Pregnenolone- and Progesterone-Treated Mice.
- 3:20 225. KAREN E. RAPP, DAN KIMBROUGH AND GERALD C. LLEWELLYN, Virginia Commonwealth University. A Simplified Method for Performing Pinealectomies on Small Mammals.
- 3:34 226. H. G. HODO, III AND B. G. MOORE, University of Alabama. Camptothecin Metabolism *In Vivo*.
- 3:48 227. RODERICK M. FARB AND B. G. MOORE, University of Alabama. Pesticide Toxicities and Interactions in Neonatal Rats.
- 4:02 228. JUDY CAIN, RODERICK M. FARB, A. W. HAYES, AND B. G. MOORE, University of Alabama. Responses of Infant Rats to Selected Mycotoxins: Ochratoxin A, Aflatoxin B₁, and Rubratoxin.
- 4:16 229. G. GATIPON AND H. LEBLANC, Louisiana State University Medical Center. Single Neuron Activity in the Medulla Oblongata of Cats in Response to Peripheral Painful Stimulation.
- 4:30 230. C. B. COBURN, JR., West Liberty State College. Sulfhemoglobin in Channel Catfish (*Ictalurus punctatus*).
- 4:44 231. ROBERT E. BALDWIN AND B. THEODORE COLE, University of South Carolina. A Correlation Between Heart Lipids and Electrocardiographic Notching Induced by Essential Fatty Acid and Choline Deficiencies.

CRYPTOGAMIC BOTANY, SESSION II

Building 171, Room C

Presiding: Dr. A. L. Weldon, Tulane University

- 1:30 232. PATRICIA G. SPERLING, University of Tennessee and RUSSELL G. RHODES, Kent State University. Growth Characteristics of Some Acidophilic Algae.
- 1:44 233. FRANK O. PERKINS, Virginia Institute of Marine Science. The Fine Structure of "Rhizoids", Holdfasts and "Slimeways" of Thraustochytriacean Phycomycetes (Saprolegniales) and Labyrinthulid Protozoa.
- 1:58 234. RICHARD C. LEONARD, University of Alabama in Huntsville. Nutritional and Metabolic Studies of Two Pigment Producing Isolates of *Spirillospora*.
- 2:12 235. HAROLD J. WEBSTER, University of Tennessee. An Approach to the Study of the Splachnaceae.
- 2:26 236. HAROLD W. KELLER AND HENRY C. ALDRICH, University of Florida. Scanning electron microscopy and freeze-etching of fructifications (peridia, capillitia and spores) of certain slime mold species.
- 2:40 Break
- 2:55 237. J. T. WYATT AND J. S. HENDERSON, East Tennessee State University. Heterotrophic Growth in the Blue-Green Algal genus *Nostoc*.
- 3:09 238. J. W. JACKSON AND J. T. WYATT, East Tennessee State University. Macro-Colony Formation in the Blue-Green Algal *Nostoc* in Culture.
- 3:23 239. L. G. PHILLIPS AND J. T. WYATT, East Tennessee State University. Some Interactions Within Four Species of *Anabaena*.
- 3:37 240. THELMA C. MARTIN AND J. T. WYATT, East Tennessee State University. Slime Layers in Blue-Green Algae.
- 3:51 241. JAMES R. MILAM AND J. W. KIMBROUGH, University of Florida. Cytological Development of *Iodophanus granulipolaris* (Pezizaceae, Ascomycetes).

CYTOLOGY AND GENETICS

Building 252, Room B

Presiding: Dr. W. Donald Fattig, University of Alabama at Birmingham

- 1:15 242. J. KENNETH SHULL, JR., Florida State University. Meiotic Prophase in *Lilium longiflorum* 'Croft' as Seen in the Scanning Electron Microscope (Angiospermae, Monocotyledonae, Liliales, Liliaceae).
- 1:29 243. V. S. RANGANATHAN AND W. DONALD FATTIG, Talladega College and University of Alabama in Birmingham. Scanning Electron Microscopy of Living Wild Type and Mutant *Drosophila melanogaster*.
- 1:43 244. CAROL J. STANTON AND JOHN R. BAYLIS, JR., University of West Florida. Characterization of spontaneous and induced mutations to benomyl resistance in *Neurospora crassa*.
- 1:57 245. R. D. HOOD, C. L. B. BENTON, JR., AND T. R. DEASON, University of Alabama, Tuscaloosa and O. F. WATSON, Druid City Hospital, Tuscaloosa. Comparative Ultrastructure of Scorpion Spermatozoa (*Vejovis carolinianus* and *Centruroides vitattus*).
- 2:11 246. W. D. DAWSON, JOAN MINTZ, M. B. MADDOCK, AND A. R. LEWIN, University of South Carolina. On Hybridization between Deermice (*Peromyscus maniculatus* and Woodmice (*P. leucopus*).
- 2:25 247. DWAYNE A. WISE, Florida State University. Natural Hybridization Between Two "Genetically Isolated" Species of *Hibiscus* (Malvaceae).
- 2:39 248. FORD CALHOUN AND H. BRANCH HOWE, JR., University of Georgia. Nutrient-dependent Inhibition of Perithecial Development in Sequential Crosses on the Same Mycelium of *Neurospora tetrasperma*.
- 3:05 249. DENISE I. PAV AND ROGER D. TILLEY, East Tennessee State University. Preliminary Study of the Chromosomal Banding Patterns in Mongolian Gerbil (*Meriones unguiculatus*).
- 3:19 250. MARY BETH THOMAS, Wake Forest University. A Fine-Structural Analysis of the Spermatozoa of *Stylochus zebra* (Turbellaria, Polycladida).
- 3:33 251. L. GERALD PARCHMAN, University of Delaware. Control of Ribosome Production during Meiosis in Lily Microsporocytes.
- 3:47 252. THOMAS E. SIMPSON, Wake Forest University. Evaluation of a Protozoan, *Metacincta Micraster* (Ciliata, Suctoria) as a Model for Cellular Senescence.
- 4:01 253. W. DONALD FATTIG, University of Alabama in Birmingham: Developmental Studies with Temperature Sensitive Mutants of *Drosophila melanogaster*.
- 4:15 254. DANIEL W. BATH, ANDREW T. L. CHEN AND ARTHUR FALEK, Emory University and Georgia Mental Health Institute. *In Vitro* Cytochemical Identification of Testicular Non-Germinal Cells from Man and Rhesus Monkey.
- 4:29 255. CHARLES J. BIGGERS, BILL A. SIMCO, Memphis State University and DEWEY TACKETT, Fish Farming Experimental Station. Inheritance Study of Five Individual Matings of Channel Catfish, *Ictalurus punctatus*.
- 4:43 256. H. DELANO BLACK, Memphis State University. Possible Heterokaryons in *Mucor hiemalis* Wehmer.

ICHTHYOLOGY AND HERPETOLOGY, SESSION IV

Building 170, Room D

Presiding: Dr. Neil H. Douglas, Northeast Louisiana University

- 1:30 257. RICHARD L. WETZEL AND JOHN P. KERR, University of West Florida. Analysis of Cohabitation by *Gambusia affinis* and *Poecilia latipinna* (Pisces: Poeciliidae) in a Saltmarsh Canal in Florida.
- 1:44 258. JOHN D. DAVIS AND HARRY L. SHERMAN, Mississippi State College for Women. Influence of Exposure to Predators on Background Choice in Color-adapted Mosquitofish, *Gambusia Affinis*.
- 1:58 259. JOHN MICHAEL FITZSIMONS, Louisiana State University. Use of mate discrimination tests in the systematics of livebearing Mexican fishes of the family Goodeidae (Atheriniformes, Osteichthyes).
- 2:12 260. WILLIAM L. SHILTON, Alabama Cooperative Fishery Unit, Auburn. Fate of the Follicular Epithelium in the Developing Oocyte of *Dorosoma petenense* (Osteichthyes, Clupeiformes, Clupeidae).
- 2:26 261. JOHN S. RAMSLEY AND R. ONFAL SMITH-ERMAN, Auburn University. Development of Color Pattern in Pond-Reared Young of Five Bass Species (*Micropterus*) of South-eastern U. S.
- 2:40 262. JOHN M. GRIFLIN AND JERRY L. WEST, Western Carolina University. Toxicity to *Salmo gairdneri* Richardson (Osteichthyes, Salmoniformes, Salmonidae) of Waste Liquor From a Neutral Sulfite Pulpmill

- 2:54 263. JAMES R. REED, JR., Virginia Commonwealth University. The Recovery of Fish Populations From the Effects of Acid Mine Drainage in the North Anna River.
- 3:20 264. DAVID H. NELSON, Savannah River Ecology Laboratory and Michigan State University. Amphibian activity along the periphery of a heated reservoir.
- 3:34 265. DIANA L. WEIGMANN AND RONALD ALTIG, Mississippi State University. Survival of immature amphibians at various combinations of anoxia and temperature.
- 3:48 266. D. BRUCE MENAS, Tall Timbers Research Station. Notes on the Breeding Biology of *Ambystoma cingulatum* (Cope) (Amphibia: Urodela: Ambystomatidae).
- 4:02 267. D. BRUCE MEANS, Tall Timbers Research Station. Osteology of the Skull and Atlas of *Amphiuma pholeter* Neill (Amphibia: Urodela: Amphiumidae).
- 4:16 268. KELLY THOMAS AND ROBERT H. MOUNT, Auburn University. Observations on reproduction in three sympatric species of *Ambystoma* in central Alabama.
- 4:30 269. KEN R. MARION, University of Alabama in Birmingham. Comparative Reproductive Ecology of an Oviparous and a Viviparous Species of the Genus *Sceloporus*.

INVERTEBRATE ZOOLOGY

Building 171, Room A

Presiding: Dr. Robert A. Woodmansee, University of South Alabama.

- 1:30 270. ROY T. SAWYER, College of Charleston and Kay Dierst-Davies, University of Wales. Some Factors Which Influence Physiological Color Change in Leeches and Observations on the Evolution of the Response (Annelida: Hirudinea).
- 1:44 271. JOHN C. HURD, Auburn University. A Survey of the Molluscs of the Chewacla and Saugahatchee Creek Drainages in Western Lee County, Alabama (Mollusca: Gastropoda and Pelecypoda).
- 1:58 272. FRANK J. S. MATURO, JR., AND MARY ANN MIDDLETON, University of Florida. Alternative Patterns of Ancestrula Development in the Bryozoan *Stylopoma informata* (Lonsdale) (Gymnolaemata, Cheilostomata, Schizoporellidae).
- 2:12 273. DONALD A. OLEWINE, Georgia Southern College. Further Observations in Georgia on the Land Planarians, *Bipalium kewense* and *Geoplana vaga*.
- 2:26 274. MADELINE P. BURBANCK AND W. D. BURBANCK, Emory University. Distinguishing Characteristics of *Cyathura estuaria* Barnard (Crustacea, Isopoda) from South Africa.
- 2:40 275. DANICE H. COSTES, Troy State University. Description of Three New Genera and Three New Species of Tomaspidini (Insecta: Homoptera: Cercopidae).
- 3:06 276. RAYMOND WILLIAM BOUCHARD, University of Tennessee. A New Genus of Crayfish from Kentucky and Tennessee (Crustacea, Decapoda, Astacidae).
- 3:20 277. JAMES D. WILLIAMS, Mississippi State College for Women and DAVID H. STANSBERRY, The Ohio State University Museum of Zoology. A Preliminary Report on the Naiad Mollusks (Bivalvia: Naiadoida) of the Tombigbee River in the Vicinity of Columbus, Mississippi.
- 3:34 278. RUDOLPH PRINS, ROBERT RUTEMILLER AND STEVEN CARDER, Western Kentucky University. Molting of the crayfish *Orconectes immunis* (Hagen) in relation to temperature, photoperiod and light intensity.
- 3:48 279. JOHN W. WATSON, JR., University of West Florida. Observations on the Responses of the Instar Stages of *Callinectes sapidus* (Rathburn) to Light.
- 4:02 280. DAVID R. KENDALL AND JAMES B. SICKEL, Emory University. Host Specificity of *Conchophthirus* (Protozoa: Ciliata) in freshwater Unionids with emphasis on species type.

PARASITOLOGY, SESSION II

Building 171, Room D

Presiding: Richard D. Garrity, Florida State University.

- 2:30 281. JAMES M. BOYLES AND BURKE L. BROWN, University of South Alabama. Comparison of Free-living and Pathogenic Strains of Soil Amebae.
- 2:44 282. GLENN M. SPONHOLTZ, Florida State University. Identification of Factors in Snail Conditioned Water Stimulatory to Miracidia of *Schistosoma mansoni*.
- 2:58 283. W. R. ALLEN, III AND REINARD HARKEMA, North Carolina State University. Histochemical Studies on Oxido-reductases in *Pharyngostomoides Adenocephala* (Trematoda: Strigeatoidea: Diplostomatidae).

- 3:12 284. JAMES R. COGGINS AND JAMES S. McDANIEL, East Carolina University. Ultrastructure of *Zygocotyle lunata* (Trematoda, Digenea, Paramphistomidae).
- 3:26 Break
- 3:40 285. PATRICIA A. STRONG, Vanderbilt University. Ultrastructural Studies on the Lymphatic System of *Megalodiscus temperatus* (Trematoda: Digenea).
- 3:54 286. B. J. BOGITSH, Vanderbilt University. Morphological and Cytochemical Studies on the Digestive Tract of *Megalodiscus temperatus* (Trematoda: Digenea).
- 4:08 287. MONTE A. MAYES AND GROVER C. MILLER, North Carolina State University. Monogenic Trematodes of Some North Carolina Centrachids.
- 4:22 288. JOHN A. MECHAM AND R. B. HILLIMAN, Virginia Polytechnic Institute and State University. A Maintenance Diet for *Australorbis glabratus* (Gastropoda, Pulmonata, Planorbidae), the Intermediate Host of Schistosomiasis Mansoni.

PLANT ANATOMY AND MORPHOLOGY

Building 168, Room A

Presiding: Dr. John M. Herr, Jr., University of South Carolina

- 1:30 289. J. M. HERR, JR., University of South Carolina. A Broader Application for 4½ Clearing Fluid.
- 1:44 290. LYTTON J. MUSSELMAN, University of North Carolina. The Trichome Complement of the Genus *Aureolaria* Raf. (Scrophulariaceae).
- 1:58 291. DAN R. SISTRUNK, Louisiana State University. A Morphological and Anatomical Study of Leaf Development in *Doxantha Unguis-Cati* (Dicotyledonae, Polemoniales, Bignoniaceae).
- 2:12 292. BRUCE B. SMITH, York College of Pennsylvania. Comparison of Sizes of Megagametophyte Stages among Five Species of *Cornus* L. (Angiospermae: Umbellales: Cornaceae).
- 2:26 293. ANN FOSTER AND CHARLES E. ANDERSON, North Carolina State University. Development of Primary Root Tissues in *Strophostyles helvola* L. (Dicotyledonae: Rosales: Fabaceae).
- 2:55 294. T. W. LUCANSKY, University of Florida. Comparative Studies of the Nodal and Vascular Anatomy in the Cyatheaceae.
- 3:09 295. RICHARD EARL ROBERTSON, Louisiana State University. The Floral Apex of *Illicium floridanum* Ellis (Dicotyledonae, Ranales, Illiciaceae).
- 3:23 296. SHIRLEY TUCKER, Louisiana State University. Wound Repair in Leaf Blades of Magnoliaceous Plants (Angiosperme; Magnoliales).
- 3:37 297. HARRY E. SHEALY, JR., AND J. M. HERR, JR., University of South Carolina. A technique for determination of stage and section plane in electron microscope studies of ovule development.
- 3:51 298. JOHN D. REYNOLDS, Virginia Commonwealth University. The influence of vacuole formation on gametophyte development in Angiosperms — a postulate.
- 4:05 299. JUDITH F. THOMAS, DR. C. E. ANDERSON, AND DR. C. D. RAPER, North Carolina State University. Floral initiation in *Nicotiana tabacum* L. 'Coker 319' in phyton-controlled environments.
- 4:19 300. EUGENE T. BERGQUIST, Environmental Quality Board, Puerto Rico. Morphogenetic response of *Myriophyllum spicatum* L. stimulated by 2,4-D.

PLANT ECOLOGY, SESSION II

Building 252, Room C

Presiding: Dr. Carl Monk, University of Georgia

- 1:00 301. ROBERT E. GANT AND EDWARD E. C. CLEBSCH, University of Tennessee. The allelopathic influence of *Sassafras albidum* on old field succession.
- 1:14 302. GEORGE T. WEAVER, Southern Illinois University. The role of annual litterfall in dry-matter dynamics of contrasting forest ecosystems.
- 1:28 303. SHARRON E. ROGERS. Shrub-tree communities of a granite outcrop.
- 1:42 304. MICHAEL GOLDEN AND H. R. DESILM, The University of Tennessee. Relating forest vegetation to site characteristics in the central Great Smoky Mountains.
- 1:56 305. LARRY W. TUCKER AND J. DAN PITHILLO, Western Carolina University. Establishment and impact of exotic plant species in Joyce Kilmer Memorial Forest.
- 2:10 306. JOE A. EDMISTON, University of West Florida. A search for a "super" legume.

- 2:24 307. MICHAEL T. EATON AND JOE A. EDMISTEN, University of West Florida. Preliminary study of nitrogen fixation in Bayou Texar, Pensacola, Florida.
- 2:38 308. PEGGY GREEN AND JOE EDMISTEN, University of West Florida. Nitrogen fixation in salt marshes near Pensacola, Florida.
- 2:52 Break
- 3:06 309. JOHN STEVENSON AND JOE EDMISTEN, University of West Florida. A preliminary report on base-line vegetation studies in the Jay Oil Field.
- 3:20 310. DWAIN T. RAYNOR AND JOE A. EDMISTEN, University of West Florida. Vegetation of the supra-littoral margin of Escambia Bay.
- 3:34 311. H. J. TEAS AND P. B. SCHROEDER, University of Miami. Vegetation analysis in the dry Tortugas.
- 3:48 312. P. B. SCHROEDER, University of Miami. Elemental analysis of Turtlegrass, *Thalassia testudinum* (Hydrocharitaceae).
- 4:02 313. BEVERLY S. AUSMUS, Oak Ridge National Laboratory. A new method to separate rhizosphere microflora from roots.
- 4:16 314. T. L. COX, University of Tennessee and Oak Ridge National Laboratory. Root production and turnover by *Liriodendron tulipifera* L.
- 4:30 315. WILLEM MELJER, University of Kentucky. The potentials of weeds.
- 4:44 316. WILLIAM H. MARTIN, Eastern Kentucky University. Forest communities of the Great Valley of east Tennessee.
- 4:58 317. RICHARD STALTER, St. John's University. Factors effecting vegetational zonation on coastal dunes, Georgetown Co., South Carolina.

PLANT TAXONOMY, SESSION II

Building 171, Room B

Presiding: Dr. A. Murray Evans, University of Tennessee

- 1:30 318. A. MURRAY EVANS, University of Tennessee. Additions to the fern flora of Mississippi.
- 1:44 319. DIANA W. MARTIN AND MARGARET Y. MENZEL, Florida State University. Confirmation of homologous genomes in some African and new world species of *Hibiscus* sect. *Furcaria* (Angiospermae: Malvales: Malvaceae).
- 1:58 320. JAMES D. YLITON, East Tennessee State University. *Houstonia montana*, a species not an ecological variety.
- 2:12 321. ANNA M. MUELLER, University of North Carolina. Disk flower variation in Coreopsis and the taxonomic implications.
- 2:26 322. K. A. FANNING AND M. P. McMAHON, University of Miami. An ecological and floristic study of south Florida vegetation extending from Biscayne Bay through the Limestone Coastal Ridge.
- 2:55 323. AARON E. BLAIR, St. Andrews Presbyterian College. Chromosome morphology of disjunct populations of Caulophyllum (Dicotyledoneae, Ranunculales, Berberidaceae).
- 3:09 324. A. J. SHARP, University of Tennessee. A new genus in the Frullaniaceae (Hepaticae). Presented by title.
- 3:23 325. MARTIN A. PIEHL, Louisiana State University. Speciation and host range in *Orobanchae ludoviciana* of the Mississippi River system.
- 3:37 326. PATRICIA G. PALMER, North Carolina State University. Preliminary biosystematic studies in the Virgata species complex of *Panicum* (Monocotyledoneae: Poales: Gramineae).

SYMPOSIUM:

"NET CARBON DIOXIDE ASSIMILATION IN HIGHER PLANTS"

Southern Section, American Society of Plant Physiologists

Building 252, Room A

Presiding: Dr. Clanton Black

- 2:00 C. R. BENEDICT, Texas A & M University. "Net CO₂ Fixation in Yellow-Green Plants."
- 2:45 S. SZAREK, University of California at Riverside. "Net CO₂ Fixation in Crassulacean Acid Metabolism Plants."
- 3:30 Coffee Break
- 3:45 M. CARTER, Auburn University. "Net CO₂ Fixation in Woody Plants."
- 4:30 R. KANAI, University of Georgia. "Net CO₂ Fixation in C₄-dicarboxylic Acid Metabolism Plants."
- 5:15 Annual Business Meeting of the Southern Section of the American Society of Plant Physiologists. PAGE MORGAN Presiding.

Abstracts of Papers Presented at the 33rd Annual Meeting of the Association of Southeastern Biologists

The number in parenthesis at the top of each abstract refers to the number of that paper in the program.

(136)

Immunization of Dogs With Gamma-Irradiated Infective Larvae of a Zoonotic Filarial Worm, *Brugia pahangi* *

HYONG-SUN AH, PAUL E. THOMPSON, FRANK E.

MITCHELL, AND JOHN C. PECKHAM

College of Veterinary Medicine, University of Georgia

The effect of attenuated nematode larval vaccine with ionizing radiation has been successfully demonstrated in a several experimental models (cf. Jarrett, *et al.*, Proc. Roy. Soc. Trop. Med. 71: 743, 1958; Miller "Radiation of medical products," I.A.E.A., Vienna, 1967; Wong, *et al.*, Bull. Wld. Hlth. Org. 40: 493, 1969; Lee, Proc. Helminth. Soc. Wash. 36: 95, 1969).

The present study was made to immunize dogs with gamma-irradiated third stage larval vaccine of *Brugia pahangi* against homologous challenge infective doses.

Twenty-eight beagles comprising 7 groups of 4 each were used as vaccinated and control groups as follows: Group A was immunized with a single dose 100 days before challenge with 100 non-irradiated larvae; Group B was immunized twice — 100 days and 70 days — before similar challenge. Group C and D were included for information on effectiveness of irradiation on the alteration of larvae used as vaccines. Group E was the challenge controls. Groups F and G give control data on the effects of multiple exposure to non-attenuated larvae. Examinations for microfilariae were done bi-weekly starting on day 75. The dogs in challenge control group (E) developed a microfilaremia within the expected period of 3 to 4 months and had a mean of 5.8 worms in their lymphatics at necropsy. The single vaccinated dogs (A) failed to develop a microfilaremia and were negative for worms at necropsy. Three of the doubly vaccinated dogs (B) died from intercurrent infection but the one survivor failed to show either microfilariae or adult worms. The results from groups C and D indicated that irradiation prevented most, but not all, irradiated larvae from developing into adult worms. Groups F and G show infections were induced and persisted for the duration of the experiment under conditions of multiple exposure to non-attenuated larvae.

* Supported by NIH Grant #A109280-2

(53)

Time of Appearance of Photosystems I and II in Chloroplasts of Greening Jack Bean Leaves

R. S. AEBERTE, J. P. THORNER * AND A. W. NAYLOR

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The time of appearance of photochemical activities together with the chlorophyll-protein complexes associated with photosystems I and II was followed in green-

ing primary leaves of jack bean (*Canavalia ensiformis* (L.) DC.). When greening of the etiolated leaves occurred under high relative humidity conditions, no lag phase in chlorophyll accumulation was observed. These environmental conditions also promoted rapid and uniform development of the chloroplast lamellar system. Chlorophyll-protein complexes of the lamellae were separated by means of sodium dodecylsulfate-polyacrylamide gel electrophoresis and by hydroxylapatite chromatography. The photosystem II complex, containing chlorophyll *a/b*-protein, was detected after 2 hrs. of greening. Its appearance was correlated with a sharp decrease in the chlorophyll *a/b* ratio and with the onset of oxygen evolution. Subsequently, the photosystem I complex, containing a chlorophyll *a*-protein, was detected — after 6 hrs. of illumination. Its appearance coincided with the detection of light-induced bleaching of P700 and the beginning of a rising chlorophyll *a/b* ratio that plateaued sometime later.

(147)

Ecology of Tree Island Margins in the Florida Southeastern Everglades

TAYLOR R. ALEXANDER, University of Miami

These islands are usually surrounded by a shallow narrow moat that is mostly free of vegetation. These moats isolate the islands from surrounding marl prairies that support sawgrass and *Eleocharis*. Data on several edaphic factors will be presented as possible reasons for the absence of vegetation. Among these will be soil salt content (conductivity), chloride levels, and pH. These were measured over several hydroperiods and salt and chloride levels appear to be controlling factors during the dry periods.

(185)

A Preliminary Survey of the Vascular Flora of St. Helena Parish, Louisiana

CHARLES M. ALEEN, Louisiana State University

The vascular flora of St. Helena Parish was surveyed; it is the first attempt to delimit the vascular flora of any of the southeastern parishes of Louisiana. The parish has a diversity of habitats: pine flatwoods, hills inhabited by *Pinus taeda* L., hills inhabited by *Pinus palustris* Miller, numerous small creek bottoms, two larger river bottoms, a small acreage of swamp, cultivated fields and one small plot of loess similar to that found in the Tunica Hills of West Feliciana Parish, Louisiana. The survey has produced two known first records for the state and several other possible first records. *Schisandra glabra* (Brick.) Rehd., *Marshallia trinerva* (Walter) Trel. and other rare species have been found. In addition, the ranges of several species have been extended by the survey. Approximately 900 species were collected with *Aster* and *Panicum* predominating.

(283)

Histochemical Studies on Oxido-Reductases in *Pharyngostomoides Adenocephala* (Trematoda: Strigeatoidea: Diplostomatidae)

W. R. ALLEN, III AND REINARD HARKEMA
North Carolina State University

Pharyngostomoides adenocephala, a trematode parasitic in the small intestine of the raccoon, was histochemically examined for the following oxido-reductases: cytochrome oxidase, catechol oxidase (phenolase), hemoglobin peroxidase, and succinic, malic, lactic, and glucose-6-phosphate dehydrogenases. Fresh, frozen sections were cut at 10 microns in an Ames Lab Tek cryostat. Incubations were carried out using the appropriate substrates, buffers, inhibitors, and control tissues. Cytochrome oxidase and the dehydrogenases were localized in most tissues, particularly those of a reproductive and/or glandular nature. Catechol oxidase was found in the vitellaria and the egg shell. Hemoglobin peroxidase was most prominent in the parenchyma surrounding the ascending uterus and the glands of the pseudo-suckers.

(119)

Morphological and Pigmentary Characters of F₁ Hybrid Tadpoles Between Species of *Pseudacris* (Hylidae, Anura)

RONALD ALTIG, Mississippi State University

Artificial hybrids crosses were made between species of *Pseudacris* and various morphological and iridophore and melanin pigmentary patterns were tabulated on pre- and prometamorphic tadpoles as compared with the parents. Such characters as post-orbital melanin gap, tail musculature pigmentation, length of labial teeth rows, marginal and submarginal oral papillae, and body and tail proportions were checked.

(100)

Fine Structure of Spore Development in *Lagenidium callinectes* Couch (Oomycetes, Lagenidiales)

HENRY V. AMERSON AND CHARLES E. BLAND
East Carolina University

Lagenidium callinectes Couch occurs as a peripheral parasite of the egg mass of the blue crab, *Callinectes sapidus* Rathbun. Fine structural observations on sporogenesis in this organism have shown that cleavage of cytoplasm is initiated by the coalescence of many small vacuoles, "cleavage vesicles." Cleavage continues until uninucleate, zoospores are delimited. The structure of free swimming spores resembles that described by other investigators for related organisms. Spore encystment is preceded by the accumulation of numerous fibrous bodies within the quiescent spore. Lamellate nuclear inclusions that resemble compound synaptenemal complexes are also obvious at this stage. An interesting feature of spore germination is the accumulation of mitochondria and fibrous bodies in the germ tube. Results presented in this study are compared with those obtained by other investigators for related organisms.

(146)

An Evaluation of a Heated Discharge on Phytoplankton Blooms in the Potomac River Estuary

BRIAN J. ARMITAGE AND GEORGE M. SIMMONS, JR.
Virginia Polytechnic Institute and State University

AND

JOHN C. WHITE, JR.
Virginia Electric and Power Company

An eight month study was conducted in the vicinity of Virginia Electric and Power Company's 461 megawatt plant at Possum Point to evaluate the contribution of the heated discharge on phytoplankton densities in the Potomac River. Upriver and downriver control stations were established, in addition to stations in the immediate vicinity of the plant. *Microcystis aeruginosa* was the most abundant alga and was visually apparent as floating mats in the Occuquan and plant intake areas. Associated with *M. aeruginosa* were *Aphanizomenon flos-aquae* and *Anabaena* spp. Algal densities indicate that the Occuquan area supported blooms 40-50% greater than those observed in the vicinity of the plant or at the downriver control stations. On the basis of the current study, we cannot attribute the phytoplankton blooms to the heated discharge. The data indicate that the atypical phytoplankton populations characteristic of the upper tidal Potomac are due to the nutrient loading from upstream urban areas.

(1)

Effects of Chronic Gamma Radiation on House Mouse, *Mus musculus* L. (Mammalia: Rodentia: Muridae) Populations

JAMES H. ARRINGTON
University of Georgia, Albany State College

In order to understand the impact of potential hazard from increased dispersion of radioactive materials into the environment, studies of radiation effects are needed at all levels of biological organization. This study was undertaken to determine the effects of chronic gamma radiation on growth rate, natality, mortality, age distribution, energy flow and mineral flow in house mouse populations. Forty populations of inbred laboratory white mice (CFW strain, *Mus musculus* L.) were divided into four groups that received 0 R/week, 15 R/week, 60 R/week and 175 R/week respectively at a dose rate of 48.5 R/hour. Measurements of population parameters in the freely growing populations are being followed for 150 days. No evidence has been obtained to indicate a significant difference in population parameters for animals receiving 15 R/week and controls. Animals receiving 60 R/week have shown measured differences in population parameters compared to controls, while population size, natality and survival have been greatly reduced in populations receiving 175 R/week.

(313)

A New Method to Separate Rhizosphere Microflora from Roots

BEVERLY S. AUSMUS¹
Oak Ridge National Laboratory²

In order to separate root and rhizosphere microfloral contributions to carbon dioxide evolution rates and nu-

trient turnover rates in forest soils, a method was devised which disallowed the taxonomic selectivity of dilution plating and the lack of discrimination of living and dead microflora of direct observations. The method is based on the adenosine triphosphate (ATP) assay using the firefly enzyme. Roots are washed in a non-ionic detergent, then surface sterilized. Both the wash and the roots are extracted and analyzed for ATP. The ATP content of the wash allows estimation of the metabolically active rhizosphere microfloral biomass. Root ATP analyses revealed an inverse correlation between root diameter and ATP content; the smallest having the highest metabolic activities. These analyses allow field estimates of root carbon dioxide evolution to be partitioned into roots and microflora. A ratio defined for ATP and several nutrients is used in estimating amounts of nutrients immobilized in microflora per unit time.

¹ Graduate Program in Ecology, University of Tennessee.

² Research supported by the Deciduous Forest Biome Project, International Biological Program, funded by the National Science Foundation under Interagency Agreement AG-199, 40-193-69 with the Atomic Energy Commission, Oak Ridge National Laboratory.

(19)

Phosphoglucose Isomerase Gene Duplication in the Bony Fishes: An Evolutionary History

JOHN C. AVISE AND G. BARRIE KITTO
Savannah River Ecology Laboratory, Aiken, S.C.

Electrophoretic patterns of phosphoglucose isomerase (PGI) in bony fishes provide strong evidence for a model of genetic control by two independent structural gene loci, most likely resulting from a gene duplication. This model is confirmed by a comparison of certain kinetic and molecular properties of the PGI homodimers (PGI-1 and PGI-2) isolated from extracts of the teleost *Astyanax mexicanus*. In addition, in all higher teleosts, the PGI enzymes show a regular pattern of tissue distribution, with PGI-2 predominant in muscle, the heterodimer often strongest in the heart, and PGI-1 predominant in liver and other organs.

An examination of 51 species of bony fishes belonging to 38 families indicates a widespread occurrence of duplicate PGI loci and an early origin of the gene duplication, perhaps in the heptolepiformes. The apparent presence of 3 PGI loci in trout and goldfish exemplify how new loci can be incorporated into the genome through polyploidization.

(176)

Malic Dehydrogenase Isozyme Patterns in Nine Isolates of Oscillatorian Blue-Green Algae

ALSIE F. BAKER AND RAYMOND W. HOLTON
*Chico State College, Chico, California AND
University of Tennessee, Knoxville, Tennessee*

Acrylamide gel electrophoresis was used to investigate the proteins and three dehydrogenase enzymes in extracts of blue-green algae (Cyanophyta) for possible use as a taxonomic tool. Aqueous extracts of lyophilized cells of nine species of Oscillatoriaceae and of *Chlorogloea fritschii* of the Nostocaceae were electrophoresed and replicate gels stained with a general protein stain and with a tetrazolium procedure for lactic, malic, and glutamic dehydrogenases. The protein

bands in the extracts were neither numerous nor of obvious taxonomic value. Lactic dehydrogenase was not detected in any extract and glutamic dehydrogenase as a single band in each of only two extracts. Malic dehydrogenase proved to be the most interesting with at least one band in all extracts and as many as three isozyme bands in some extracts. The different localizations of these bands in the Oscillatorian species reflected in part the two morphological groups studied while the *Chlorogloea* pattern differed markedly from the others. In addition to adding to our present meager knowledge of enzymes detected in blue-green algae, the results suggest the possible use of isozymes in the taxonomy of Cyanophyta.

(231)

A Correlation Between Heart Lipids and Electrocardiographic Notching Induced by Essential Fatty Acid and Choline Deficiencies

ROBERT E. BALDWIN¹ AND B. THEODORE COLE
University of South Carolina

Male, weanling, Holtzman rats were maintained on control, fat-free, fat-supplemented, choline-deficient, and choline-supplemented dietary regimens. Electrocardiographic analysis at the end of the 75-day experimental period showed that the only consistent anomaly was a notching of the QRS complex in the electrocardiograms of those animals maintained on fat-free and choline-deficient diets. Total heart lipids were separated into six neutral and five phospholipid fractions by thin-layer chromatography. Gravimetric analysis of these fractions revealed that the lecithin fraction, which averaged 17% of the total lipid in the control group, decreased significantly to 9.5% in the fat-free group and 10.0% in the choline-deficient group. Cephalin:lecithin ratios which were 1:1 in the control, fat-supplemented, and choline-supplemented animals increased to 2:1 in the fat-free and choline deficient animals. The interrelationship between reduced lecithin levels in the heart and QRS notching will be discussed.

¹ Present address: The Citadel, Charleston, S. C. 29409

(79)

Principles of Soil Protozoogeography

STUART S. BAMFORTH
Newcomb College of Tulane University

Most soil protozoa can tolerate a variety of temperature and geochemical conditions, and these abiotic factors affect them through vegetation. Vegetation directs food supply: easily decomposable leaves (e.g., deciduous plants) produce large bacterial populations favoring flagellates, naked amoebae, and ciliates; more slowly decomposing vegetation (e.g., bryophytes, conifers) produce quantities of humic materials favoring testacea. Moisture fluctuations affect the abundance and diversity of protozoan species. The influence of vegetation and moisture within the general parameter of temperature will be shown by constructing a soil protozoa map of Louisiana, and extending these concepts to areas of varying vegetation and humidity in Colorado and New Mexico.

(30)

The Histones of *Lemma*: Changes Observed under Flowering Conditions

J. T. BARBER AND J. K. LIVINGSTON
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New Orleans, La. 70118

Aseptic cultures of *L. gibba* G3 were raised under conditions designed to maintain either vegetative growth or to induce flowering. Plants were sampled at various times during such treatments and their histones were extracted and analyzed by polyacrylamide gel electrophoresis. Plants which remained vegetative, whether growing under non-inductive, or even under inductive conditions, showed little variation, either qualitative or quantitative, in their histone contents. However, plants which underwent floral induction and initiation showed dramatic changes in their histone contents; initially both the numbers and amounts of histone decreased then subsequently they increased to a higher level than had been present in the original vegetative tissue. The results will be discussed in terms of the suggested role of histones in the regulation of gene activity and in the light of current knowledge concerning floral induction in this and other systems. (Supported by a Grant-in-Aid of Research from Sigma Xi).

(59)

Innate Dormancy in Southern Pine Seeds

JAMES P. BARNETT
Southern Forest Exp. Sta., USDA
Pineville, La.

Dormancy in southern pine seeds seems to reflect a balance between the expansive force of the embryo and constraint by the coat. The rate and percent of dark germination were low in untreated *Pinus taeda* L. seeds. Both increased with seedcoat clipping or removal, but not the level of stratified seeds. Coats did not reduce the rate of initial water imbibition but did limit total uptake prior to germination, probably by restricting swelling of the megagametophyte and embryo. Respiration followed the pattern of water absorption in decoated seeds. However, it was at a common low level in stratified, clipped, and unstratified seeds until germination began, and there seemed to be no causal relation between respiration and coat permeability.

Further evidence of mechanical constraint by the seedcoat was shown when it was determined that 69 percent of the variation in rate of germination in five pine species of varying dormancy was related to coat weight as a proportion of total seed weight. Seeds used in these tests were collected and processed so as to minimize secondary dormancy which can modify innate dormancy. The validity of the constraint hypothesis was also supported by other tests made to evaluate the relative importance of gaseous permeability and mechanical constraint.

(97)

Effects of the Parasitoid, *Microplitis croceipes* on the Hemolymph Proteins of *Heliothis zea*

DONALD J. BARRAS, R. L. KISNER, W. J. LEWIS
Troy State University, Troy, Alabama

Parasitism of the corn earworm *Heliothis zea*, by *Microplitis croceipes* resulted in differences in the number and location of host proteins when separated by

disk electrophoresis. These results suggested that the parasitoid may break down or utilize certain host proteins and cause the release or synthesis of other proteins by the host. Furthermore, the parasite may utilize or destroy certain host hemolymph proteins while causing a shift in free amino acids of the host to the bound state or the secretion of other proteins into the hemolymph. The result demonstrates that the parasite extracts or uses a large amount of protein from the host during its development, while other organic constituents like lipids appears to be consumed primarily during the day before emergence.

(151)

The Light Factor in the Germination Ecology of *Draba verna* L.

JERRY M. BASKIN AND CAROL C. BASKIN
University of Kentucky

The greatest majority of the seeds of the winter annual *Draba verna* L. require light for germination, but light can be given before the seeds are fully after-ripened and as long as 4 months before temperature and moisture conditions are made favorable for germination. Seeds that are exposed to light in late spring or in late spring and early summer and then removed to constant darkness can germinate in darkness under favorable temperature and moisture conditions in autumn, even after passing through a long unfavorable (for germination) wetting and drying period at high summer temperatures in darkness. The light requirement for germination probably is not an important factor restricting *D. verna* to open, well-lighted habitats.

(254)

In Vitro Cytochemical Identification of Testicular Non-Germinal Cells from Man and Rhesus Monkey

DANIEL W. BARTH, ANDREW T. L. CHIEN
AND ARTHUR FALEK
Emory University and Georgia Mental Health Institute

As part of an *in vitro* study on primate testicular cells, cytochemical identification was made of the non-germinal elements to determine if a correlation exists between cell type and *in vitro* cellular morphology. In culture, the non-germinal cells attached to the surface of the flasks and formed two morphological cell types. The epithelial-like cells, abundant in primary cultures, were still observed after the third sub-culture but could not be identified in later subcultures. Cytochemical analyses of primary cultures demonstrated that the epithelial-like cells contained some lipid and were PAS-positive. From these data it would appear that the epithelial-like cells are Sertoli cells.

The fibroblast-like cells, found in primary cultures in approximately equal numbers to the epithelial-like cells, were seen exclusively after the fourth subculture. Cytochemical tests revealed that the fibroblast-like cells were a mixed population with respect to both lipid and glycogen content. The fibroblastic type of growth appears to be composed of both Sertoli cells and Leydig cells or fibroblasts.

(222)

The Platelet Count as Affected by Changes in Serotonin Levels in the Rat

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AND GERALD C. LLEWELLYN
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Rat platelets, like those of other species, take up serotonin from the plasma against high concentration gradients. Serotonin enters the cell via specific uptake sites where it is concentrated. It was conceived that the blood platelet might serve as a rapid-ferrying mechanism for the direct transport of brain serotonin to the intestine and other tissues.

The protocol for this investigation required that young albino rats of both sexes be used for obtaining platelet counts following pre-treatment with p-chlorophenylalanine (PCPA), a selective depletor of brain serotonin, and reserpine, an agent which releases serotonin from its storage sites. After having obtained base-line (control) counts, the study consisted of three phases. Comparative platelet counts were made using rats treated with PCPA only, with reserpine only, and with rats treated with both PCPA and reserpine. The counts were made using phase contrast microscopy at varying time intervals following drug injections.

The results from this investigation indicated that in general the greatest increase in platelet numbers occurred at two hours following drug treatment. Although increases were observed to occur in the number of platelets mobilized in all animals treated with a single drug and at all time intervals following injection, it was apparent that only when both PCPA and reserpine were injected into an animal was the highest possible cell count obtained.

(162)

Uptake and Translocation of the Alkali Metal Ions by Rye Plants

VERYL E. BECKER AND DONALD R. ORT
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Winston-Salem, North Carolina 27109

Rye seedlings were germinated and grown in the dark for three days. Subsequently, they were transferred to Hoagland's nutrient solution containing the respective alkali metal ion additions. After aeration and exposure to light for four days the leaves and stems of the plants were harvested and ashed. Alkali metal ion concentrations in the respective ashed samples were determined by flame photometry and atomic absorption spectrophotometry. The relative levels of uptake and translocation ranging from highest to lowest was the following: $K^+ > Rb^+ > Na^+ > Cs^+ > Li^+$. The influence of Ca^{++} on the uptake and the translocation of some of these ions also was determined. The results will be interpreted in reference to the physical properties of the ions.

(124)

Members of the Order Siluriformes Collected in the Amazon River at Puerto Nariño, Colombia

EUGENE C. BECKHAM, III AND HERBERT T. BOSCHUNG, JR.
University of Alabama

Expeditions to the Amazon River at Puerto Nariño, Colombia, in June, 1971 and January, 1972 were conducted for the purpose of obtaining samples of the ichthyofauna of that region. The eight catfish families represented in these collections were studied and the results are briefly discussed.

(71)

The Suitability of Two Types of Artificial Substrates in Assessing the Impact of an Industrial Effluent on Stream Macroinvertebrate Community Structure

ERNEST F. BENFIELD, ALBERT C. HENDRICKS
AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

Replicates of two types of artificial substrates were placed at one station upstream from an industrial outfall, and at three downstream stations. The substrates were retrieved after four weeks and the colonizing macroinvertebrate invertebrates were removed, sorted, identified, and counted.

Comparisons of the relative qualitative and quantitative sampling efficiencies of the two substrate types are discussed.

(300)

Morphogenetic Response of *Myriophyllum spicatum* L. Stimulated by 2,4-D

EUGENE L. BERGQUIST
Environmental Quality Board, Puerto Rico

Consideration was given to the morphogenetic response of *M. spicatum* to the butoxyethanol formulation of 2, 4-D at 1 ppm. The epidermis, outer cortex, endodermis, and vascular tissue showed no response to the treatment. Cell divisions which were stimulated in the aerenchymatous septa resulted in an increase in thickness. The nodal septa also became multilayered by a similar process. Mitosis without cytokinesis resulted in a number of binucleate cells. Both the active growing regions in the shoot apex and the quiescent growing regions in the axillary buds vigorously responded. Rampant cell divisions and growth formed extensive tumors in these. The pericycle in the nodal region was stimulated so numerous division centers were initiated and amorphous masses of cells developed. These tumors spread extensively into the internodes. Lysogenetic processes appeared on the surface of the tumors and young adventitious roots; they also resulted in the complete disintegration of the multilayered aerenchymatous and nodal septa.

(213)

Morphometric Measurements, Body Composition, and Elemental Content of Small Florida Fish

ROBERT J. BEYERS, BARBARA J. BEYERS,
AND MICHAEL H. SMITH
Savannah River Ecology Laboratory

In February of 1969, small fish were collected from 19 shallow water habitats in Florida. The most numerous species were: *Gambusia affinis*, *Heterandria formosa*, and *Poecilia latipinna*. (Class: Teleostomi, Order: Cyprinodontiformes) Miscellaneous other species were sampled. Fish were frozen on dry ice in the field and returned to the laboratory. At the laboratory the fish were thawed, classified as to species, and length and wet weight of each individual were recorded. The animals were dried on a freeze dryer to determine dry weight. Each dried fish was then digested in a perchloric acid—hydrogen peroxide solution. The resulting solution was analyzed for magnesium, calcium, potassium, and sodium. Samples of water from each collection site were also analyzed.

In this paper, the relationships between length-weight curves over a fairly wide geographical area are discussed. The effects of mineral content on the elemental composition of each species and the various species groups in each are explored.

(255)

Inheritance Study of Five Individual Matings of Channel Catfish *Ictalurus punctatus*

CHARLES J. BIGGERS¹, DEWLY TACKETT²,
AND BILL A. SIMCO¹
¹Memphis State University
and ²Fish Farming Experimental Station

Five ponds were stocked with eggs from five different matings of *Ictalurus punctatus*. Two spawns were divided and placed in separate ponds for control studies. Variation in growth within single spawns were compared with growth made by fish from different spawns. Electrophoretic analysis of the blood plasma was made from each spawn. The frequency of catfish with deformed tails indicates that this characteristic may be inherited as a simple recessive.

(35)

Effects of Low Temperature and Light on Isocitratase and Isocitrate Dehydrogenase Levels During Tobacco Seed Germination

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Germination and initial growth rates of tobacco (*Nicotiana tabacum*) seedlings were associated with levels of isocitratase. Such seedlings were allowed to imbibe in the dark for 24 hours before irradiation for 12 hours with 65-75 foot-candles of soft white fluorescent light; subsequent germination was in the dark. Omission of the light treatment lowered the rate of germination and levels of isocitratase and isocitrate dehydrogenase. When seeds were exposed to low temperature (5°C. for 6 hours), isocitratase activity was significantly reduced while isocitrate dehydrogenase activity increased. A longer exposure (12 hours) to low

temperature resulted in a greater depression of isocitratase without similarly affecting isocitrate dehydrogenase activity. Gibberellic acid, indole acetic acid, and ribonuclease additions to the incubation medium are being investigated as possible replacements for the light stimulation of tobacco seed germination and isocitratase activity.

(256)

Possible Heterokaryons in *Mucor hiemalis* Wehmer

H. DELLANO BLACK
Memphis State University

"Direct germination" of the zygospores of *Mucor hiemalis* as pure heterothallic is the usual case. However, "mycelial germinations" do occur occasionally. These mycelial germinations were generally assumed to be of a pure heterothallic nature also. Incorporation of five biochemical auxotrophs and one morphological mutant, into compatible crosses in this heterothallic organism resulted in zygospore formation. Some zygospores germinated by the method designated "mycelial germination." A number of such germinations were tested for heterokaryosis. The results show that heterokaryosis does exist in such germinations and that apparently wild-type nuclei may exhibit a dominance over auxotrophic nuclei.

(323)

Chromosome Morphology of Disjunct Populations of *Caulophyllum* (Dicotyledoneae, Ranunculales, Berberidaceae)

AARON E. BLAIR, *St. Andrews Presbyterian College*

The genus *Caulophyllum*, composed of two species, *C. thalictroides* of North America and *C. robustum* from Asia, displays a disjunct distribution that apparently developed in the Lower Miocene. In addition, *C. thalictroides* has a disjunct distribution between the Appalachian Mountains and Piedmont in the southeastern United States that most likely developed after the last glacial period. All plants studied had a diploid chromosome number of sixteen. No chromosome differences between the various populations of *C. thalictroides* were detected. *C. robustum* has two karyotypes. Karyotype A lacks a large chromosome pair with median region centromeres found in karyotype B. The karyotype of *C. thalictroides* differs from karyotype A of *C. robustum* by three chromosome pairs and from karyotype B by two pairs. The length of time the various populations and taxa have been separated and their high degree of chromosome similarity suggests the genus *Caulophyllum* possesses considerable karyotypic stability.

(106)

Light and Electron Microscopic Observations of Host-Parasite Relationships in Southern Corn Leaf Blight

ROBERT O. BLANCHARD, *University of Georgia*

Lesions produced by *Helminthosporium maydis* on corn inbreds B37N and B37T were examined by scanning and transmission electron microscopy in conjunction with light microscopy. Conidia germinated on the leaf surface where germ tubes characteristically formed

at both ends of each conidium. Appressoria generally developed at the ends of relatively short germ tubes, although longer germ tubes produced occasional appressoria. Appressoria usually formed between the junction of two epidermal cells and rarely over stomata. Infection pegs from the appressoria penetrated the leaf and formed subepidermal vesicles which initiated hyphal proliferation within the leaf. Appressoria and hyphae closely appressed to the leaf surface had a sheath of uncharacterized material which was believed to facilitate their attachment to the leaf. This sheath corresponded to noticeable areas of hyphal thickness seen in stained fresh mounts. This research was supported by CSRS Special Grant #177-15-03.

(99)

Observations on *Lagenidium callinectes* Couch:
Isolation and Development
(Oomycetes, Lagenidiales)

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East Carolina University

A strain of *Lagenidium callinectes* Couch, isolated from the ova of crabs collected in the Newport Estuary, North Carolina, was brought into agar culture, and studied with regard to growth and sporogenesis. The vegetative thallus consists of both intramatrix hyphae, which may completely fill infected ova, and extramatrix hyphae, which may grow from egg to egg or function in the discharge of cytoplasm prior to spore formation. In sporogenesis, the cytoplasm from a given septum delineated portion of the thallus migrates through a specialized, non-branched, extramatrix hypha into a gelatinous vesicle that forms at the hyphal tip. The cytoplasm does not flow as one large mass, but rather as individual cytoplasmic units that are connected in sequence by a cytoplasmic thread. Cleavage of the cytoplasm occurs inside the vesicle with subsequent spore discharge through a break at the distal end of the vesicle. Once released, the spores swim away immediately.

(195)

Preliminary Comparison of Two Oxidation Ponds
with Different Trophic States in Central Virginia

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Virginia Commonwealth University

Investigations were initiated to compare floral and faunal associations inhabiting two oxidation ponds with different trophic features. The two adjacent 0.7 hectare oxidation ponds were built to receive cage wash water from the Virginia Commonwealth University Animal Research Facility. At the initiation of the study, one of the two-year-old ponds had received the high nutrient containing waste water. This pond had phytoplankton nutrient and productivity levels associated with eutrophic ponds, the other had low corresponding values, and was considered oligotrophic. Ammonia, phosphates, nitrates, iron, carbonate, bicarbonate, silica and chloride differed the most markedly of nutrients analyzed. Toward the end of this preliminary study the effluent was diverted to the oligotrophic pond.

Primary productivity by ^{14}C uptake, total extractable chlorophyll, chemical analysis of major nutrients and phytoplankton taxonomic analysis were sampled on a

weekly basis for three months. The study continued through the early weeks of effluent diversion to the oligotrophic pond. The differences between the ponds declined significantly after the diversion and productivity decreased with seasonal change.

(84)

The Influence of Temperature upon Embryonic
Diapause and Seasonal Regulation in *Sympetrum*
vicinum (Hagan) (Odonata: Libellulinae)

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CHARLES E. JENNER,
University of North Carolina at Chapel Hill

Laboratory and field studies were combined to elucidate the influence of temperature upon embryonic development and seasonal regulation in *Sympetrum vicinum*, a north temperate zone anisopteran. Eggs collected over a three-year period were observed from oviposition to hatching to ascertain the developmental behavior at constant temperatures and when exposed to a variety of time-temperature regimes. The thermal coefficients of eight morphological stages were determined. The temperature requirements of specific morphological stages revealed three physiological periods designated as pre-diapause development, diapause development, and post-diapause development. Developmental behavior indicated that the physiological processes responsible for the rate of diapause development could be removed temporarily from the actual morphological stages assigned to this physiological period. The rate of diapause development could be accelerated by exposing eggs to initial temporary low temperature treatments. The influence of temperature upon the life cycle and the distribution of the species were determined through field observations.

(22)

Age and Growth of the Sand Perch,
Diplectrum formosum, (Pisces: Serranidae)
from North Carolina

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Age of sand perch, *Diplectrum formosum* (Linnaeus), from coastal North Carolina is determined using otoliths, scales, and vertebrae. The three methods are discussed as to appropriateness. Also considered is the relative agreement of data using all three methods. Back calculations, in order to determine growth rates, are made employing the data from the above sources. The overall projection of this data is to make comparisons with previously published age and growth information on sand perch from the northern Gulf of Mexico. Theoretically, higher latitude populations (North Carolina) should grow at slower rates and live to a greater age than lower latitude populations (Gulf of Mexico). This hypothesis is tested and a comparison is made with an intermediate latitude population.

(128)

A New Darter of the Subgenus *Ulocentra* from the Caney Fork River System in Tennessee (Osteichthyes, Perciformes, Percidae)

RAYMOND WILLIAM BOUCHARD, *University of Tennessee*

At the present time there are at least five undescribed species of *Ulocentra* within the state of Tennessee that are under study. This new species adds a sixth undescribed *Ulocentra* to the state's faunal list. Preliminary investigations have located specimens only in that part of the Caney Fork River system that drains the Eastern Highland Rim. Streams flowing from the Cumberland Plateau have not yielded any darters of the Subgenus *Ulocentra*. The only *Ulocentra* represented in streams draining the Nashville Basin currently conform to *Etheostoma atripinnae*. Characters for separating the new species from the nominal *E. atripinnae*, *E. coosae*, *E. duryi*, and *E. sinuotum* are given. Comparative color data of breeding specimens of the above species are included.

(276)

A New Genus of Crayfish from Kentucky and Tennessee (Crustacea, Decapoda, Astacidae)

RAYMOND WILLIAM BOUCHARD, *University of Tennessee*

Until 1965 *Cambarus cornutus* was known only from a single form I male collected November 3, 1874, from the Green River near Mammoth Cave, Kentucky. A series of this species was collected in 1947 but was unknown until the University of Michigan crustacean collection was unpacked at the Smithsonian Institution in 1968. The former Subgenus *Barbicambarus* Hobbs possesses characters sufficiently different from other genera to justify its elevation. The principle characters which differentiate this monotypic genus are exhibited in the chelae; antennae; annulus ventralis; and coxae of fourth pereopods and pleopods of the male, form I. This species is known only from the Barren and upper Green River systems in Kentucky and Tennessee. Its usual habitat under large boulders certainly contributed to its scarcity in previous collections.

(12)

Population Dynamics of a Parasite, *Neoechinorhynchus pseudemydis*, the Yellow Bellied Turtle, *Pseudemys scripta scripta* in a Reservoir Receiving Thermal Effluent from a Nuclear Reactor

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Wake Forest University

The occurrence of the parasite in turtles (*Pseudemys scripta*), the definitive host, is discussed. Consideration is given to sex ratio and size structure of parasites as a function of position in the digestive tract, and location, date, sex and size (age) of the host.

(281)

Comparison of Free-Living and Pathogenic Strains of Soil Amebae

JAMES M. BOYLES AND BURKE L. BROWN

Trophozoite growth responses of two strains of limax soil amebae from Mobile, Alabama, are compared with those of the HB-1 strain known to cause amebic meningoencephalitis in humans. Preliminary studies indicate no pathogenicity in rats for the Mobile strains. Population development when allowed to feed on a variety of bacteria at 22°C. and at 37°C. is measured and compared. The suitability of various types of bacteria for maintenance of ameba stocks is determined.

This research was supported in part by a grant from the University of South Alabama Research Committee.

(149)

An Analysis of Land Use Patterns of Georgia Uplands Using Species Diversity Methodology: A New Approach in Plant Geography

JOEL H. BRASWELL AND G. L. PLUMMER
University of Georgia

Most diversity studies have concentrated on the population-community level of organization. The question arises: can a meaningful index of diversity be developed at the community-ecosystem level of organization? Land use of Georgia uplands was surveyed using the line intercept method. The patterns of land use were then evaluated by the function $H' = -\sum p_i \ln p_i$. The results indicate that different diversities of land use exist in the 5 unique geographic regions within the state. The Lower Coastal Plain was found to be the most diverse region while the Mountain area was the least diverse. These data indicate that diversity indices may serve as a useful research method in plant geography. (Research supported in part by NSF Grant GB-30363.)

(214)

Preliminary Studies of ¹³⁷Cs Radionuclide Whole Body Burdens in Birds of the AEC Savannah River Plant

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Savannah River Ecology Laboratory

Preliminary studies have been conducted on the whole body burdens of the radionuclide ¹³⁷Cs in birds of the AEC Savannah River Plant. Analyses of over 200 individuals representing 25 species indicated that a mosaic of points of environmental radionuclide contamination is subdivided to greater or lesser degrees by birds of varying home range sizes.

Small passerine species, such as the kingbird, tend to subdivide such a mosaic finely with high variability between the body burdens of individuals collected in closely adjacent areas. Species with larger home range sizes, such as the crow, tend to act as integrators across the contamination mosaic and therefore show less variability in body burden between individuals. Initial studies have been designed to quantify the role of waterfowl and other migratory species as transporters of radionuclides away from sites of contamination.

(286)

Morphological and Cytochemical Studies on the Digestive Tract of *Megalodiscus temperatus* (Trematoda: Digenea) *

B. J. BOGITSH, *Vanderbilt University*

Morphological and cytochemical studies employing the electron microscope have been conducted on the digestive tract of *Megalodiscus temperatus*. The digestive tract is found to consist of two regions, the foregut and the ceca. The former region is characterized by the presence of a lining continuous with the general tegument of the organism. Its primary functions appear to be ingestive and sensory. The latter function is limited to the pharyngeal pouches whose linings contain numerous sensory structures. The cecal region is characterized by a syncytial gastrodermis whose luminal surface is thrown into numerous microvilli composing a prominent brush border. Acid and alkaline phosphatase activities as well as acid glucosaminidase activity are associated with the brush border. Numerous Golgi complexes are observed in the gastrodermis, and it is believed, on the basis of the test for macromolecular diglycols, that they are responsible for the elaboration of carbohydrate-containing secretions. The main component of the diet of the organism is blood. It is hypothesized that the iron portion of the hemoglobin molecule is regurgitated as a soluble compound.

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(204)

Terrestrial Activity of Two Species of *Bufo*

LINDA A. BRIESE AND DR. MICHAEL SMITH
Savannah River Ecology Laboratory

Two species of *Bufo* are commonly found on the Savannah River Project, Aiken, South Carolina. Through the use of pit fall traps and a drift fence surrounding an old field, terrestrial activities of *Bufo terrestris* and *B. quercicus* have been observed. Trends in seasonal movement, habitat distribution and activity patterns were determined both intra- and interspecifically. These trends were compared with a similar situation in a nearby pond.

(108)

An Unusual Gland in the Opossum

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When the opossum (*Didelphis virginiana*) is distressed, a viscous, green, malodorous fluid, much like pus in appearance, exudes through single papillae located on either side of the anus. The fluid contains many blood cells. It comes from bilateral spherical glands which are ensheathed by striated muscle and connective tissue. Each gland has a long narrow duct. Embedded in the investing tissues are smaller apocrine lobules. These lobules are drained by a duct paralleling and merging with the other duct. The mucosa of the lumen of the main gland is separated from the submucosal connective tissue by a basal lamina. Mast cells are found in the submucosa along with extravasated polymorphonuclear leukocytes, plasma cells, and some erythrocytes and lymphocytes. The extravasated cells penetrate the basal lamina and infiltrate through the intercellular spaces of the loosely interdigitating mucosal

cells. Eventually they arrive at the lumen. The mucosal cells contain granules which may contribute to the secretion.

(57)

The Post-Illumination CO₂ Burst in C₄ Grasses

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Grasses possessing the 4-carbon dicarboxylic acid cycle of CO₂ fixation exhibit little evidence of photorespiration. Many of these species do show a post-illumination CO₂ burst (PIB). Grasses belonging to the tribes Paniceae and Andropogoneae lack the PIB, with the exception of some species in the genus *Panicum*. Species tested in the tribes Chlorideae, Eragrostae and Unioloae showed the PIB. The PIB was insensitive to O₂ concentration, but increased with light intensity to 4,000-5,000 ft-c. The PIB increased as temperature was decreased from 35 C to 15 C. Labelling experiments with ¹⁴CO₂ indicated that the CO₂ evolved in the PIB is not from carbon incorporated into organic compounds.

(107)

Osmotic Pressure Changes in Cerebrospinal Fluid and Their Relation to Morphogenesis of the Chick Brain

JOHN M. BROWNE, *Atlanta University*

During normal morphogenesis many hollow structures typically undergo a period of rapid expansion. The osmotic pressure (OP) of cerebrospinal fluid (CSF) was measured between days 4 to 8, a period of expansion. A marked increase occurred between days 5 to 7, 288 to 351 milliosmols, followed by an abrupt decrease at day 8. During this period the salt concentration of CSF remained the same, indicating that the OP changes are due to an organic compound. Blood OP remained constant at all times. This temporary increase in OP could readily account for the increase in CSF and brain expansion. The visible reactions of 4-day chick embryos (*in ovo*) to dimethylsulfoxide (0.5 ml injected into the air sac) were studied with time-lapse photography. This treatment produced considerable swelling of the entire embryo, but especially of the neural tube and eyes. This gross swelling was sometimes followed by rupture of the midbrain wall and abnormal development of the entire brain. These DMSO-induced changes in the brain were preceded by a gross increase in the OP of CSF, up to 516 milliosmols, far greater than those noted in normal embryos. This exaggerated increase in OP appears responsible for abnormal swelling and rupture of the neural tube. Thus a correlation was found between changes in the chemical and physical characteristics of CSF and some normal and abnormal changes in brain morphogenesis.

(Aided by NIH grant HD00641.)

(88)

The Effect of Temperature on Metabolic Rate, Thyroid Morphology and Blood Glucose Levels of the Garter Snake

Thamnophis sirtalis parietalis (Say)

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Virginia Polytechnic Institute and State University

AND

St. Olaf College

Specimens of *Thamnophis sirtalis parietalis* were acclimated to 2, 11, 20, 29, and 34 C. Acclimation was determined by stabilization of metabolic rate. The mean metabolic rates respectively were .028, .039, .062, .082, and .164 cc/gm/hr. Blood glucose levels showed a similar trend except at 2 C where there was considerable scatter. Respectively, the mean blood glucose values were 41.2, 12.7, 19.1, 18.4, and 29.9 mg. per cent. Temperature had little effect on the percent of thyroid epithelium and respectively the mean values were 9.4, 8.9, 8.5, 10.7, and 11.6 percent.

Supported by a Grant from the Research Foundation to St. Olaf College.

(274)

Distinguishing Characteristics of *Cyathura estuaria* Barnard (Crustacea, Isopoda) from South Africa

MADELINE P. BURBANCK AND W. D. BURBANCK

Emory University

Although described as a new species in 1914 by K. H. Barnard, *Cyathura estuaria* was later considered synonymous with *C. carinata* (Kröyer) by this same author. Examination of specimens, including adult males, from Knysna Estuary, South Africa, supplied by Dr. J. H. Day, suggests that *Cyathura estuaria* Barnard should be reestablished. Some of the differentiating characteristics of *C. estuaria* are:

1) complex tip of the appendix masculina same length as the endopod of the second pleopod and the hooked rod arises medially on the lateral lobe, while the tip in *carinata* extends beyond the endopod and the hooked rod arises at angle of lateral lobe.

2) propodus of male gnathopod does not have a protrusion on proximal lateral margin which occurs in *carinata*.

3) pereopods with a short, broad unguis and a subequal tooth at the tip of the dactyl while the tips of the dactyls of *carinata* are prolonged, black tipped, and the tooth is less than $\frac{1}{2}$ the length of the unguis. There are also differences in the dorsal patterns, setation of the mandibles, and degree of fusion of 6th pleonite with telson. (Work supported by NSF Grants GB-3122 and GB-7777.)

(211)

The Effect of Increasing Temperatures on Mortality Rates of Bluegills (*Lepomis macrochirus* Raf.) Exposed to A Toxic Concentration of Zinc

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Virginia Polytechnic Institute and State University

Bluegills were exposed to a temperature-zinc interaction consisting of five temperature regimes and a toxic concentration of zinc which was 32 mg Zn^{++}/l (calculated as Zn^{++} from $ZnSO_4 \cdot 7H_2O$). The above concentration of Zn^{++} and a control with no Zn^{++} present were tested on five groups of fish which had been acclimated to (1) $20 \pm 1^\circ C$, (2) $30 \pm 1^\circ C$ and fish which had been acclimated to $20 \pm 1^\circ C$ and were exposed to temperature increases at the following rates up to a maximum of $30^\circ C$: (3) $1^\circ C/24$ hours, (4) $1^\circ C/1$ hour and (5) $1.5^\circ C/10$ minutes. Ten fish were exposed to each temperature treatment in both 32 mg Zn^{++}/l and a control.

This study demonstrated that a rise in temperature increased the mortality rate of bluegills exposed to a lethal concentration of Zn^{++} . The increase in mortality rate was a function of the rate at which the environmental temperature was increased. At 32 mg Zn^{++}/l , where all fish died within 24 hours, fish exposed to the faster rates of temperature increase died more rapidly according to the following order of treatments: $1.5^\circ C/10$ minutes $> 1^\circ C/1$ hour $> 1^\circ C/24$ hours or $20^\circ C$ acclimated fish. Bluegills acclimated to $30^\circ C$ and tested at $30^\circ C$ died faster than the fish acclimated and tested at $20^\circ C$.

(168)

Influence of Maleic Hydrazide on Dry Weight Distribution in Tobacco Plants

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Maleic hydrazide (MH) is applied to burley tobacco to inhibit axillary bud development following removal of the apical meristem. Inhibition of axillary bud development by MH causes a decrease in total dry weight/plant and weight of stem but causes an increase in dry weight of the leaves when compared with hand removal (controls) of the axillary buds as they develop. Leaf area of MH treated plants increased slightly compared with the controls but leaf weight/unit area increased 20% over the controls. Photosynthetic activity or $^{14}CO_2$ fixation was not altered by MH treatment. MH treatment reduced ^{14}C translocation from the $^{14}CO_2$ treated leaf by 30% in short term experiments. In MH treated plants the greatest amount of the ^{14}C that moved out of the treated leaf was found in leaves above the treated leaf and within an angular distance of $\pm 30^\circ$ of the treated leaf. Most all of the remainder of the ^{14}C leaving the treated leaf was found in the leaves below and within $\pm 30^\circ$ angular distance of the treated leaf and the roots. In the controls most all of the ^{14}C was found in the leaves below and within $\pm 30^\circ$ angular distance of the treated leaf and the roots.

(143)

Some Strigeate Trematodes from the American Woodcock. *Phiohela Minor* (Gmelin)

E. E. BYRD AND S. R. PURSGLOVE, JR.

A total of 324 specimens of *Phiohela minor* (Gmelin), American Woodcock, were searched for parasites; they came from Alabama, Arkansas, Florida, Georgia, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Jersey, New York, South Carolina and West Virginia and from Ontario, Canada. No strigeates were recorded from Florida, Massachusetts and Mississippi although 50 of the hosts came from these states. At least 5 species of strigeates were recovered. Seventy (21.6%) of the hosts harbored *Pseudapatemon aldousi* McIntosh, 1935 (family Strigidae), and the infection occurred in birds from all areas except Alabama, Florida, Massachusetts and Mississippi. The other strigeates were diplostomatids; they belonged to *Allo-diplostomum* Yamaguti, 1935 and to an undescribed genus. Two species were recorded for each of the genera. The *Allo-diplostomum* species came from all areas except Arkansas, Florida, Maine, Massachusetts, Mississippi and South Carolina. Eighty-two (25.3%) of the birds carried species of the genus. Fifty-one (15.7%) of the host birds harbored flukes representing two species of the new genus. The host birds so infected came from all areas except Florida, Massachusetts, Minnesota, Mississippi and Missouri. This study was supported by an appropriation from the Congress of the United States with funds administered and research coordinated under the Federal Aid in Wildlife Restoration Act (50 Stat. 917) and through contract Nos. 14-16-0008-676 and 14-16-0008-585, Bureau of Sport fisheries and Wildlife.

(228)

Responses of Infant Rats to Selected Mycotoxins: Ochratoxin A, Aflatoxin B₁ and RubratoxinJUDY CAIN, RODERICK M. FARB, A. W. HAYES,
AND B. G. MOORE
University of Alabama

It is known that certain mycotoxins which are secondary metabolites of various fungi, may be either toxicogenic and/or carcinogenic in mature test animals. Little information concerning the response of very young animals to these environmental toxins has been collected. Each mycotoxin was dissolved in corn oil and administered orally by stomach tube to neonatal rats. Dose-level studies showed that there are substantial differences between the neonatal and reported adult lethal doses of all three mycotoxins. Daily weight gains were affected in animals given sublethal doses of rubratoxin and ochratoxin. Aflatoxin, which is more toxic than rubratoxin, does not exhibit such an effect on infant animals. Treatment of the mother during gestation, 5 days before birth, with aflatoxin also did not enhance the response of neonates to its sublethal doses of rubratoxin. Additionally, treatment of the mother with aflatoxin during late gestation, 2 days before birth, caused deaths of the neonates. A similar experiment with rubratoxin did not show evidence of a toxic trans-placental transfer to the littermates. It has also been demonstrated that the simultaneous administration of sublethal doses of ochratoxin and rubratoxin results in additive toxicity of these mycotoxins.

(248)

Nutrient-dependent Inhibition of Perithecial Development in Sequential Crosses on the Same Mycelium of *Neurospora tetrasperma*FORD CALHOUN AND H. BRANCH HOWE, JR.
University of Georgia

Perithecia develop only at locations on the mycelium of *Neurospora* where fertilizing elements of the opposite mating type, such as conidia, have been applied. This characteristic is the basis of the conidial spotting procedure, which simultaneously tests several strains on the same mycelium for mating type or other traits. It was found, however, that when the conidial spotting procedure was applied to a mycelium on different days, rather than simultaneously, perithecia subsequently developed only where conidia had been spotted the first day. This inhibition of the second cross by the first cross on the same mycelium was observed to be independent of volatile metabolites and pH, independent of non volatile metabolic products, reversible by addition of nutrients, and correlated with the concentration of the carbon source. An explanation for the inhibition which is based upon the lowering of the concentration of nutrients in the medium is presented.

(200)

Analyses of Zinc Levels in Bottom Samples and Aquatic Macroinvertebrates from a River Receiving a Zinc-Rich Industrial Effluent

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A survey was made of the bottom fauna present in the Juniata River near the FMC Plant, Lewistown, Pa. Kick samples and mud samples were obtained at each of four stations. Hydrochloric acid extraction and atomic absorption spectrophotometry methods were used to determine the zinc levels present in both the mud and bottom fauna present at each station. The zinc levels in the bottom samples were compared to those in the benthic invertebrates. Comparisons were also made of the zinc content per unit weight of various invertebrate species present at each station. Results were analyzed to determine if a positive correlation existed between substrate zinc levels and the zinc concentration in benthic invertebrates. The invertebrate zinc levels were investigated to show the possible mechanism by which the benthic community structure was altered.

(60)

Protein Patterns in the Shoot Apical Region and the Leaf Sets of *Osmunda cinnamomea* L. (Pteropsida, Osmundales, Osmundaceae)JAMES D. CAPONETTI, *University of Tennessee*

The patterns of soluble proteins in the shoot apical region and in the leaf sets of cinnamon fern have been determined by disc electrophoresis. The highest numbers of protein bands occur in gels from the shoot apical region and from the youngest sets of leaf primordia. The band numbers decrease as the primordia become progressively older and more highly differentiated except for a slight increase of band numbers in the oldest sets of mature leaves. Cinnamon fern produces three kinds of leaves: bud scales (cataphylls), vegetative or sterile

leaves (trophophylls), and sporangia-bearing or fertile leaves (sporophylls). The distribution of protein bands in the shoot apical region and in the leaf sets will be compared with the occurrence of some of the more common isoenzymes in an attempt to correlate protein and enzyme patterns with the development and differentiation of the three leaf types.

(179)

Relationship of Nucleic Acid and Protein Synthesis To Zoospore Formation In *Protosiphon botryoides* Klebs

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AND J. C. O'KELLY, *University of Alabama*

Continuous cultures of the alga *Protosiphon botryoides* synchronized by a 48 hr repeating regime, which alternates 36 hrs cool-white illumination with 12 hrs long wavelength visible light, yields a culture of almost 100% zoospores at the end of the 48 hr cycle. The DNA, RNA and protein content of the cultures throughout the cycle have been monitored by standard colorimetric techniques. To supplement this data and to elucidate the importance of DNA, RNA and protein to zoospore formation, pulse labeling and metabolic inhibitors have been employed, specifically during the 12 hr period of long wavelength illumination. DNA content of the culture continues to increase throughout the 48 hr cycle and indicates a 24 hr periodicity in synthesis. RNA and protein synthesis show no 24 hr periodicity but a sharp decline in synthesis is noted during the last 12 hours of illumination. Inhibitors of DNA synthesis have no effect on zoospore production, whereas, RNA and protein synthesis inhibitors virtually eliminate it.

(160)

Measurements of Phloem Transport Velocity in Cotton

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Studies of the basic factors involved in phloem transport were carried out on 4 month old *Gossypium hirsutum* L. var. Lankart and included a combination of techniques. In preliminary experiments 1.17 μ C of 50 μ C/mg glucose-¹⁴C was applied to the distal adaxial portion of the petiole of the twelfth true leaf. Tissue section analysis for radioactivity at measured intervals from the tracer application site yielded the velocity of transport and a profile of the activity in the transport stream. Transport velocities exceeded 200 cm/hr within 10 minutes after introduction of the tracer.

Plants sprayed with a 100 ppm auxin solution 18 hrs. prior to tracer application had transport velocities more than twice that of the control plants. The radioactivity profiles of these plants also differed from the controls.

(103)

Location and Periods of Water Mold Activity in a Lake

JOHN CLAUSZ, *St. Andrews Presbyterian College*

Experiments determining the effects of time on the viability of zoospores revealed that less than 90% of the

zoospores are alive after 24 hours of endogenous metabolism. Indications are that if zoospores are not able to germinate in one or two days, they are of little long term survival value. Since zoosporogenesis is preceded by a period of vegetative activity, the collection of zoospores indicates a period of vegetative activity in the very recent past. It can be said that the number of spores in a collection is related to the amount of growth and reproductive activity occurring at or just prior to the time of collection.

A seasonal and spatial study of the distribution of zoospores of the Saprolegniaceae in a North Carolina lake revealed that the periods of greatest fungal activity occurred in the spring and fall. During these periods species of *Leptolegnia* and *Saprolegnia* were more active than other species. Species of *Achlya* were rarely active in the early spring but were conspicuously active in late summer. More fungal activity occurs at the shallower locations than at the deeper location perhaps reflecting a greater abundance of food sources. At the deep location fungal spores occasionally were collected from an oxygen deficient zone. However, experiments determined that fungi placed in the oxygen deficient zone were unable to grow or sporulate while the same fungi were able to grow and sporulate in aerated levels of the lake. Thus spores collected from the oxygen deficient zone drifted into this zone from above.

(125)

Fishes of the Jourdan River System in Southern Mississippi

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Mississippi State University

A survey of the fishes of the Jourdan River system, a tributary of St. Louis Bay, is based on 78 collections from 29 localities. A total of 70 species representing 29 families were taken. Of these species 47 are restricted to freshwaters; the remaining species are euryhaline. Ecologic and zoogeographic notes are presented.

(230)

Sulfhemoglobin in Channel Catfish (*Ictalurus punctatus*)

C. B. COBURN, JR., *West Liberty State College*

Sulfhemoglobin longevity was investigated in the channel catfish (*Ictalurus punctatus*) by incorporating sulfur-35 into the hemoglobin of the fish and periodically counting S-35 per ml. of blood from the fish. The fish lost all S-35 from their hemoglobin within 24 hours of being in S-35 free water. It was hypothesized that either the erythrocytes containing S-35 were lysing or the sulfhemoglobin (S-35) was dissociating and the S-35 was excreted. Both hypothesis were checked by *in vivo* and *in vitro* methods. It was concluded that sulfhemoglobin (S-35) was dissociating. Sulfur-35 was rapidly lost from the fish's hemoglobin when the fish were placed in S-35 free water. It was concluded that while sulfur was bound reversibly with channel catfish hemoglobin, some of the hemoglobin was in the form of sulfhemoglobin as long as the fish is in water containing sulfur.

(284)

Ultrastructure of *Zygocotyle lunata* (Trematoda, Digenea, Paramphistomidae)

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East Carolina University

A study of the fine structure of certain portions of *Zygocotyle lunata* (Dies., 1836) Stunkard, 1917, a caecal parasite of water birds, revealed that the tegument possessed the same fundamental organization as has been described previously for other digenetic trematodes. The surface was covered by a syncytial cytoplasmic layer which connected by projections through integumentary muscle layers to parenchymally situated, nucleated cell bodies. The free surface was characterized by folds and secondary convolutions, but typical microvilli were not observed and the surface was not channeled. The thick tegumental layer contained mitochondria and numerous electron-dense spherical and rod-shaped inclusions. Accumulations of the rod-shaped bodies lay near the outer membrane surface. The tegumental cells had dense cytoplasm and nucleus and contained large quantities of either or both types of inclusion. A flame-cell proved to be composed of a large hexagonally-shaped bundle of cilia suspended within an excretory tubule.

(34)

Phenolic Replacement of Light Requirement in 2 Photomorphogenic Systems

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The red light requirement for leaf unrolling in dark grown barley (*Hordeum vulgare*) seedlings was completely replaced by 0.7 umolar caffeic acid. Higher concentrations were observed to inhibit while concentrations as low as 1 umolar were still promotive. Responses similar to caffeic acid were observed with diethyldithiocarbamic acid and ethylenediaminetetraacetic acid.

Higher concentrations of caffeic acid also stimulated hook opening in *Phaseolus vulgaris*. Preliminary experiments indicate regulatory parallels between hook opening and enzymes involved in phenol biosynthesis and manipulation—eg. phenylalanine ammonia lyase, peroxidase, polyphenoloxidase, etc.

(163)

Absorption of Cobalt by Excised Barley Roots

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⁶⁰Co absorption by excised roots of *Hordeum vulgare* appears to be an active process exhibiting a Q_{10} of 2.2. The effects of poisons also indicate active absorption. After 1 hr. difluorodinitrobenzene at a concentration of 5000 micromolar inhibited cobalt absorption 80%, while carbonyl cyanide phenylhydrazone at 10 micromolar and dinitrophenol at 500 micromolar inhibited rates by 62% and 57% respectively. A study of absorption kinetics over a concentration range of 1 to 100 micromolar CoCl_2 indicates that a number of carrier sites are available for absorption depending upon the concentration.

Results which were consistent with this interpretation were obtained when the concentration of a competing ion, Ni^{++} , was varied. The effects of other divalent cations on absorption rates will be discussed. An exchangeable, adsorbed fraction amounting to approximately 25% of the total cobalt present in the tissue after 1 hr. of absorption was found to be present. Varietal differences in absorption rates have been observed.

(88)

A New Method for Monitoring Respiration Rate in Crayfish *Crustacea Decapoda, Cambarus bartonii* and *Procambarus clarkii*

MARILYN A. COLEMAN AND ALAN G. HEATH
Virginia Polytechnic Institute and State University

Specimens of two crayfish species, *Procambarus clarkii* and *Cambarus bartonii* ranging from 10-42 grams were used to test a new indirect and inexpensive method of monitoring ventilation frequency. Five silver electrodes were stretched over a plexiglass plate and barred only under the region of the scaphognathites to pick up ventilation movements. This method was successfully employed in both flowing and static systems and in concentrations of 0-2,000 ppm zinc and 50,000 ppm NaCl. The monitor detects movements of either one or both scaphognathites, and may be used for long term experiments.

(77)

Notes on the Natural History of *Idotea metallica* (Isopoda: Idoteidae) from the Eastern Mediterranean

SNEED B. COLLARD, University of West Florida

Isopods collected by neuston net from the *R/V Atlantis II* were placed in XBT packing cases and exposed to salinity, temperature, pressure, light and electrical stress. Substrate color and texture preferences and reproductive and feeding behavior characteristics were noted. Specimens tested were found to be euryhaline, eurythermal and unaffected by drastic pressure changes. Substrate preferences are obscure. Reproductive behavior is initiated by the male who seeks then holds the female (who becomes quiescent) for a week or more. Specimens are voracious carnivores and cannibalistic upon young and molting adults.

(203)

Effect of Aroclor® 1248, a Polychlorinated Biphenyl, on Growth of Populations of *Tetrahymena pyriformis* W (Ciliata: Hymenostomatida: Hymenostomatidae)

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Populations of *Tetrahymena pyriformis* W were grown in optically-matched test tubes at 26°C in broth (2% proteose peptone, 0.1% yeast extract, 0.5% dextrose) that contained 0.1% polyethylene glycol 200 and 10, 100, or 1,000 ppb Aroclor 1248, a polychlorinated biphenyl (PCB). Population density was measured in a spectrophotometer as absorbance at 540 mμ. Growth rate dur-

ing exponential growth of the population was estimated as the quantity b of the least squares estimate by the line $y = a + bx$ of the exponential portion of the graphed data. In addition, population densities at 96 hours, when control population density is maximal, were compared. Significant reductions in growth rate (18.9%) and population density (9.6%) ($P < 0.05$, randomized block analysis of variance plus Scheffé procedure) were produced by 1,000 ppb of the PCB, but not by lesser concentrations tested.

Gulf Breeze Laboratory Contribution #140.

(98)

The Water-mold Disease of Rice in Louisiana

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Louisiana State University

A seed-rot and seedling disease of water-planted rice was observed throughout the rice production areas of Louisiana in the spring of 1971. Typical disease symptoms consisted of rotted seed when the seedling flood was removed or stunting and rapid death of emerged seedlings. Affected seeds and seedlings were covered with white or tan fungal mycelium, which radiated across the soil surface. The disease was severe in fields planted in early March when weather conditions were unfavorable for germination and growth of the seedlings. Fungi isolated from diseased seeds and seedlings were predominantly species of *Achlya* and *Pythium*. *Achlya* isolates were identified and used singly or in combination with a selected *Pythium* isolate in pathogenicity tests. The *Pythium* isolate and the *Achlya* spp. were pathogenic in growth chamber tests. The *Pythium* isolate or combination of *Pythium* with various *Achlya* isolates were more pathogenic than any *Achlya* sp. alone.

(275)

Description of Three New Genera and Three New Species of Tomaspidini (Insecta: Homoptera: Cercopidae)

DANICE H. COSTES, Troy State University

Three new genera and three new species of Tomaspidini from Central and South America are described. The major morphological characters used in these descriptions are the male genitalia which are illustrated.

(314)

Root Production and Turnover by *Liriodendron Tulipifera* L.*

T. L. COX, University of Tennessee AND
Oak Ridge National Laboratory

Root production and mineral losses were estimated for *Liriodendron* seedlings grown in three different soil types by use of destructive sampling and separation into size classes for mineral assay. Mineral turnover via root death was found to be a function of clay content of the soil. During the study period, root death was significant in all soils and amounted to from 5 to 8 percent of the total root dry weight. Diameter and weight measurements of dead roots showed that over 90 percent of the turnover at the sampling dates observed occurred in the 2 smallest root size-classes (less than 0.5 cm). Most of this turnover was in roots less than 0.1 cm in diameter (75 percent). Relative mineral concentrations in living roots were $K > Ca > Mg > P$. Content in-

creased 2 to 4 fold with each decreasing diameter size class. This was due to an increase in metabolically active tissue per gram dry weight in smaller roots as demonstrated by the high correlation ($r^2 = 0.9967$) between surface area-to-volume ratio and CO_2 production in *Liriodendron* roots.

* Research supported by the Eastern Deciduous Forest Biome Project, International Biological Program, funded by the National Science Foundation under Interagency Agreement AG-199, 40-193-69 with the Atomic Energy Commission — Oak Ridge National Laboratory.

(85)

A Comparison of Two Macroinvertebrate Samplers and Regular Stream Sampling Techniques

JOHN S. CROSSMAN AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

Comparisons were made between basket-type macrobenthos samplers, floating artificial substrate samplers, and regular sampling methods using a statistical technique developed by Wilhm and Dorris.¹ The diversity indices ($\bar{d}$) obtained indicated that the bottom basket samplers had values (3.25-4.66) in the same "clean water" (> 3.0) range as three rectangular bottom net samples (3.44-4.22) and a combined, 5 ft², Surber sample (3.16). The floating artificial substrate samplers consistently had lower $\bar{d}$ values (1.60-2.99) than the other sampling techniques. The lower diversity indices appeared to result from the selective colonization of the floating samplers by stream drift organisms. (Research supported by the Appalachian Power Company.)

¹ Wilhm, Jerry L. and T. C. Dorris. 1968. Biological parameters for water quality criteria. *BioScience*, 18(6): 477-481.

(86)

A Preliminary Study of the Pelecypoda in the Upper Clinch River

JOHN S. CROSSMAN, JERRY C. SMRCHEK,
AND JOHN CAIRNS, JR.

Virginia Polytechnic Institute and State University

A pelecypod study was undertaken on the upper Clinch River from Kyles Ford, Tennessee to Tazewell, Virginia during the summer and fall of 1971. The purpose of this study was to determine the species composition, species diversity, and distribution of the naiad populations. Collections were obtained at all the upper river sites sampled by Ortmann in the early 1900's plus four additional stations. The extra stations were sampled to determine the effects of road construction, sewage, and industrial activities. In general, pelecypod populations were more diverse at the downstream stations and had greater numbers than at the upstream stations. Eliminated or greatly reduced populations were also noted below Raven, Virginia and Carbo, Virginia because of the discharge of raw sewage and a fly ash pond spill, respectively. (Research supported by the Appalachian Power Company).

(61)

Studies of Calf Thymus Histone in Male Induction in *Volvox aureus* M5

EDWIN H. CROWDER AND WILLIAM H. DARDEN
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Male colonies can be induced in *Volvox aureus* M5 by a combination of calf thymus histone and a phenol extract from *Volvox*. Total calf thymus histones have been fractionated by carboxymethylcellulose chromatography and the fractions tested for ability to induce male colonies. All intact histone fractions are active in the assay system.

(46)

Immunochemistry of Phytochrome

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Vanderbilt University

Molecular weight determinations of phytochrome suggest the existence of two size classes of the chromoprotein, a larger molecule of approximately 240,000 molecular weight (large phytochrome) and a smaller molecule of approximately 60,000 molecular weight (small phytochrome). We have investigated the relationship between large and small phytochrome using a specific antiserum prepared by challenging a rabbit with large phytochrome. By incubating a crude phytochrome preparation, obtained from etiolated Garry oat seedlings, in darkness for several days at 4°C., we followed the conversion of large phytochrome to the smaller species using an immunoelectrophoretic assay. We find that the precipitin band obtained initially with the crude extract is indicative of large phytochrome and is replaced during incubation by two new precipitin bands. One of the new bands is indicative of small phytochrome while the other is distinct from that obtained with either molecular weight species. We conclude that small phytochrome does not arise by a simple disaggregation or hydrolysis of large phytochrome into identical sub-units since the large molecule upon degradation yields in addition to small phytochrome one or more peptide chains which are both electrophoretically and immunologically distinct from small phytochrome.

(184)

Notes on the Foliar Indument of *Elephantopus* L. (Compositae) in Louisiana

MARY-GRACE CURRY, Louisiana State University

Because stomates function in association with physiological processes, the stomatal apparatus may be under genetic control and reflect evolutionary aspects, taxonomic relationships and external physical conditions. The foliar indument of three species of *Elephantopus* was studied. Included is a general description of both the adaxial and abaxial epidermis, trichomes and stomatal ratios and densities. An average of 360 density counts were made per species. The stomatal ratios in the Louisiana species of *Elephantopus* is species specific and may be of taxonomic significance.

(67)

Specificity of a Phenol Extract from *Volvox* (Volvocaceae) in Male Induction

WILLIAM H. DARDEN, JR.
University of Alabama, Tuscaloosa

The differentiation of male colonies in *Volvox aureus* M5 can be induced by a combination of calf thymus histone and a phenol extract from *Volvox*. Similar extracts from *Euglena*, *Chlamydomonas* and *Protosiphon* are inactive. Variations in extraction methods which yield active extracts are described.

(16)

Geographic Variation in the Pond Slider, *Pseudemys scripta*, in Alabama

JOHN M. DAVIDSON AND ROBERT H. MOUNT

Eight characters in *Pseudemys scripta* show geographic variation in Alabama. Populations referable to *P. s. elegans* occur in the western portion of the Tennessee drainage and in the upper Tombigbee drainage. The other populations inhabiting major streams of the Mobile Bay drainage are intergradient between *P. s. scripta* and *elegans*.

Pseudemys s. scripta inhabits the isolated pond and swamp habitats within much of the Lower Coastal Plain region of southeastern Alabama, as well as some of the small streams. Influence from this subspecies is detectable in other populations northward to the Tennessee River.

A determination of the extent, if any, to which *P. s. troostii* influences populations of Alabama pond sliders must await a reconsideration of the status of that questionable form.

(207)

A Quantitative Study of Wingflashing by the Eastern Mockingbird, *Mimus Polyglottus* in Two Agonistic Contexts

J. D. DAVIS, V. S. CAIN, J. R. DAVIS, R. C. DEATON, L. GREEN, AND W. A. LEWIS, JR.
Mississippi State College for Women

A quantitative study of wingflashing in mockingbirds was made in two agonistic contexts by tape recording (1) the responses of six nesting pairs to a stuffed owl (mobbing response) and (2) the responses of eight nesting pairs to a stuffed male mockingbird (with tape recorded song) placed within their territories (territorial defense). A total of 180 minutes of behavior was analyzed. The frequency of the events immediately preceding and immediately following wingflashes in both contexts was tabulated, and a goodness of fit test was performed to determine if the frequency of some events was significantly different for the time intervals immediately before and immediately after wingflashing. Wingflashing was both more frequent and more "patterned" during mobbing than during territorial defense, supporting the hypothesis that wingflashing is an intention movement associated with "anxiety-evoking" situations.

(258)

Influence of Exposure to Predators on Background Choice in Color-Adapted Mosquitofish, *Gambusia affinis*

JOHN D. DAVIS AND HARRY L. SHERMAN
Mississippi State College for Women

The mosquitofish, *Gambusia affinis*, rapidly color adapts when placed on black or white backgrounds. Black-adapted fish essentially all choose black backgrounds when placed in a choice apparatus. White-adapted fish collected from different localities vary in their background choices when placed in a choice apparatus.

Samples of 100 fish were collected from different localities in northeastern Mississippi, color-adapted to white containers, and given three successive trials in a background choice apparatus. Ninety percent of the fish from Reynold's Pond, a small pond heavily stocked with predator species, chose the appropriate white background in all three consecutive trials. Sixty percent of the fish from Lake Lowndes, a large impoundment stocked with bass, chose the appropriate white background in three consecutive trials. Only twenty-one percent of the *Gambusia* from the predator-free stream on the MSCW campus chose the white background in three consecutive trials.

Fish from the predator-free stream were placed in two tanks, one with predators and one without. At the end of two weeks they were tested in the choice apparatus. Seventy percent of the fish exposed to predators chose white backgrounds in three consecutive trials when white-adapted, whereas forty-two percent of the fish not exposed to predators did so.

(218)

Seasonal Differences in the Response of the Reproductive Tract of the Lizard, *Anolis carolinensis*, to Elevated Temperatures and Timed Injections of FSH

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AND DONALD L. LEWIS
Memphis State University

During the last five years data has accumulated implicating temporal synergisms in the regulation of seasonal events in practically all classes of vertebrates. Green anoles, *Anolis carolinensis*, were injected with 20 μ g (female) or 10 μ g (males) of mammalian FSH (Sigma) daily at the beginning, middle, or end of a 12-hour photoperiod at a constant temperature for 10 days. In October neither 22° nor 31°C stimulated growth of the female reproductive tract; however, 26° and 31° stimulated both ovarian and oviducal growth in December. FSH increased the response and was equally effective at all times of the day in October, being significantly more effective at the higher temperature. In December FSH was significantly less effective when injected at the middle of the photoperiod at 26° and most effective on the ovarian response at the end of the photoperiod at 31°C. In males tested in November the testes responded equally at 26° and 31°C. No diurnal difference in the response to FSH was apparent at 31°C. Hormone injections in the middle of the photoperiod were ineffective in increasing testes weight in animals held at 26°C.

(246)

On Hybridization Between Deermice (*Peromyscus maniculatus*) and Woodmice (*P. leucopus*)

W. D. DAWSON, JOAN MINTZ, M. B. MADDOCK
AND A. R. LEWIN
University of South Carolina

Hybridization between deermice (*Peromyscus maniculatus*) and wood mice (*P. leucopus*) was attempted using artificial insemination. A liveborn litter of three was born to one of two deermice inseminated with woodmouse sperm at post partum estrous, but this litter survived only two days. Eleven inseminations at estrous in cycling mice produced no liveborn litters, but gave evidence of abortive pregnancy. Early pre-implantation hybrid embryos appeared normal, but there was reduced sperm penetration of eggs. In 31 artificially cross-inseminated mice, employing hormonally induced ovulation and implantation, 16 resorption sites in 13 mice were observed on days 15 and 16 of gestation, but there were no live fetuses at this age. Twenty-eight intra-specific controls produced 10 mice bearing live fetuses at equivalent age. Difficulty in obtaining viable hybrids from this cross suggests that natural hybridization between these species is unlikely.

(20)

Osteology of the Eel *Myrophis punctatus* (Osteichthys, Anguilliformes, Ophichthidae)

DAVID M. DEAN, *University of South Alabama*

The osteology of *Myrophis punctatus* is described in part. Emphases include the cephalic lateralis system, the branchiostegals, and the vertebral column. The relationship of the genus *Myrophis* and the family Ophichthidae is discussed.

The vertebral and rib configuration suggest that the genus is closely allied with *Ahlia* but not *Muraenichthys*. The ethmoid commissure, frontal commissure, and high and variable number of branchiostegals suggest that the ophichthid lineage is not directly related to any other modern family of eels.

(198)

Organic Content of Waters and Sediments in Four Aquatic Habitats in Mississippi

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Organic content of waters and sediments from 4 aquatic habitats in Mississippi, namely Catahoula Creek, Jourdan River, St. Louis Bay, and Mississippi Sound, were estimated from loss on ignition at 600°C for 2 hr. The average organic content of waters are: creek — 0.04 g/l; river — 0.05 g/l; bay — 1.48 g/l; and sound — 3.38 g/l while the average organic content of sediments are: 1.39 g/kg, 5.36 g/kg, 58.73 g/kg, 148.00 g/kg respectively. Organic content of both water and sediment progressively increased from creek to sound, with 1-2 orders of magnitude separating the freshwater creek and river from the marine bay and sound. The ecological significance of fractionating organic content of water into particulate, subparticulate, and dissolved constituents is discussed and the importance of bottom organic deposits to benthic feeders is suggested.

(134)

Life Cycle Patterns in the Leipertrematinae (Trematoda: Dicrocoeliidae)

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Life cycles of *Paradistomum mutabile*, *Platynosomum fastosum*, *Conspicuum icteridorum*, *Zonorchis petiolatum* and *Eurytrema pancreaticum* were reviewed and similarities as well as differences in their basic cycles emphasized. The morphology of the mother brood mass, sporocyst, cercaria and metacercaria were compared with comparable stages in the Dicrocoeliinae. The continuous production of sporocysts for months by the mother brood mass and the simultaneous development of a fixed number of cercariae in the sporocysts of the Leipertrematinae is in sharp contrast to the simultaneous production of a single generation of sporocysts by the mother brood mass and the continuous production of cercaria for several months by the sporocysts in the Dicrocoeliinae. The subfamily designation of several genera is discussed.

(150)

Inferences from Remote Sensing of Forest Landscapes

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Using both very recent and somewhat older ground truth and a DC-3 flown quadri-camera system, a forested mountain in Tennessee was examined. Relationships between film data and ground acquired data was sought. Vegetation attributes include tree density, tree basal area, crown diameter, crown closure, fallen log density as well as certain site characteristics.

(18)

Reproductive Periodicity of the Loggerhead Sea-turtle, *Caretta caretta*. (Reptilia: Chelonia)

MICHAEL W. DIX AND JAMES I. RICHARDSON
*University of Georgia and
Little Cumberland Island Association*

Remigration and nesting activities of tagged loggerhead turtles on Little Cumberland Island were systematically recorded for the past 8 seasons. Analysis of remigration returns indicates that females of this species apparently differ from *Chelonia mydas* in the period between successive nesting seasons with a 2-yr cycle being most frequent (60%). Cycles of 3-yrs, and 1- and 4-yrs (11 and 9% respectively) also occur. One-year cycles have not previously been recorded for any species of sea-turtle. Two- and three-time returns suggest that the cycle may be modulated, and changes from a 2- to 1-yr or a 2- to 3-yr cycle may occur. The significance of these results in terms of the distances travelled by the turtles between nesting periods, and ecological factors regulating this periodicity is discussed.

(118)

Salivary Enzymes of Some Colubrid and Crotalid Snake Species (Reptilia, Squamata)

MICHAEL W. DIX, T. R. DIX AND M. R. LOOMIS,
University of Georgia

The distribution and relative activity of acid and alkaline phosphatases, acetylcholinesterase, and proteases in the salivary secretions of several colubrid snake species, *Natrix sipedon*, *Thamnophis sirtalis*, *Elaphe obsoleta* and *Drymarchon corais* was determined. These activities were compared with the levels observed in *Agkistrodon* and *Crotalus* species. In the sample studied high levels of protease activity were correlated with the presence of a differentiated serous or seromucous section of the supralabial salivary gland.

(44)

Some Effects of Light and Feeding Precursors on Anthocyanin Biosynthesis in Dark-Grown *Zea mays* (L)

STEPHEN O. DUKE AND AUBREY W. NAYLOR,
Duke University

After 3 days of germination in complete darkness, seedlings, excised roots, and excised first internodes of *Zea mays* (L) cv. Pioneer 3369A were transferred to 2% sucrose plus antibiotic solution and then placed back in the dark or in continuous white light. Anthocyanin production was observed within 14½ hours in excised organs and 13½ hours in intact seedlings exposed to light. Phenylalanine and cinnamic acid decrease the requirement to 12 hours in excised roots and intact seedlings while completely inhibiting anthocyanin production in excised first internodes. Presence of the coleoptile, coleoptilar node or seed with root attached prevented inhibition of anthocyanin production. Induction of anthocyanin synthesis is not affected by DCMU in this system.

(80)

Introduced Land Molluscs of the United States

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Louisiana State University in New Orleans

We have knowledge of over 200 species of foreign molluscs which have been reported as being present in the continental United States. These molluscan invaders are not limited to land; both freshwater and marine forms occur also.

Most of the introduced land molluscs live in cultivated areas or habitats greatly modified by human activities.

These molluscs come from all over the world and arrive in various ways. We do have programs which are attempting to stop the invasions but, as is obvious by the large number present here, they are not entirely effective.

(173)

Ethylene Synthesis in Peanut Embryos

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C. M. LYMAN AND J. M. PRESCOTT
Texas A&M University

An aminotransferase was isolated and partially purified from germinating peanut seed (*Arachis hypogaea* L. cv. Starr) that transaminates methionine to α -keto- γ -methylthiobutyrate, which in turn is readily converted to ethylene by a free radical type reaction. Transamination proceeded in the light as well as the dark, and a racemic mixture of DL-methionine was a more effective substrate than either the D or L isomer. Pyridoxal-5'-phosphate was essential for maximum enzymatic activity as were reducing agents during extraction and purification of the enzyme. Of the α -keto acids tested, pyruvate proved to be the most effective acceptor of the amino group from methionine and as purification of the enzyme progressed, the specificity for pyruvate increased. Purification of the enzyme was accomplished by precipitation, first with ammonium sulfate, then acetone, followed by fractionation on a Sephadex G-200 column. During purification the enzyme appeared to form an aggregate. Aggregation was not prevented by the commonly used reagents, but its formation was slower in the presence of these reagents. The active fraction from the Sephadex G-200 column gave only one band on polyacrylamide gel electrophoresis. The proposed intermediates of the transamination reaction (alanine and α -keto- γ -methylthiobutyrate) were isolated from the reaction media and, on a molar basis, compared favorably with the amount of ethylene formed. Since an enzyme was found in peanut embryos which transaminates methionine, the most active ethylene precursor known, transamination appears to be a feasible first step in ethylene synthesis. The proposed intermediate, α -keto- γ -methylthiobutyrate is present in sufficient quantities to produce ethylene at a level that corresponds to that produced by intact embryos which is physiologically active in the germination of peanut seed.

(94)

Spermine as a Stimulator of *Escherichia coli* tRNA Methylases

ANITA F. DYI AND B. G. MOORE,
University of Alabama

Inhibitors and stimulators of animal tRNA methylases have been implicated in the biochemistry of carcinogenesis. Polyamines such as spermine are present in tissues of animals and are thought to be involved in certain basic control mechanisms. One researcher has shown that various polyamines stimulate liver tRNA methylases *in vitro* and may play roles in the *in vivo* regulation of these enzymes by switching on and off enzyme inhibitors. Since polyamines influence cellular division in bacteria, we were interested in the *in vitro* effects of the polyamines on bacterial tRNA methylases. Our results show that spermine enhances *in vitro* methylase activities, however, it appears to be an effect that does not require the presence of dialyzable enzyme inhibitor. Stimulation was obtained on 100,000 x g supernatants and dialyzed enzyme preparations. Similar results have been obtained with these enzymes treated with NH_4 ions. Results will also be presented to contrast the profiles of base methylations after spermine and NH_4 ion treatments.

(307)

Preliminary Study of Nitrogen Fixation in Bayou Texar, Pensacola, Florida

MICHAEL T. EATON AND JOE A. EDMISTEN,
University of West Florida

A study of nitrogen fixation with primary emphasis on the water column, and sediment, is being conducted in Bayou Texas, Pensacola, Florida by utilization of a modified acetylene reduction technique (Stewart, Fitzgerald, and Burris, 1967). The production of ethylene as a measure of nitrogen fixing ability was detected by gas chromatography. Test results from the water column, sediment, attached alga, and shoreline vegetation, are yielding a significant insight into the nutrient status of the Bayou. Color slides of the site, technique, and results, will be presented. The value of the acetylene reduction technique in the study of nitrogen fixation in aquatic systems will be discussed.

(306)

A Search for a "Super" Legume

JOE A. EDMISTEN, University of West Florida

Many paper companies are now adding mineral fertilizer to pine lands to increase and speed tree growth. This practice may prove ecologically and economically expensive. The use of selected native legumes is suggested as an alternative. This preliminary report describes research done in a survey designed to find a legume or nodulated nitrogen fixing non-legume suitable for use in open pine lands. Such a plant must fix nitrogen at a high rate as measured by: (1) the acetylene reduction test, (2) a high nitrogen content of its tissues, and (3) high NH_3 or total nitrogen content in the soil around the plant. The successful candidate for the "super" legume title must be able to grow well in the pine land habitat and withstand such environmental stresses as fire, drought, and competition with weeds. Plants tested and observed in this search include: *Myrica*, *Ceanothus*, *Baptisia*, *Lupinus*, *Crotalaria*. *Baptisia* appears to be the best all around candidate.

(65)

Fast Growth Responses in the Primary Root of *Zea mays*

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University of North Carolina, Chapel Hill

The effects of pH and auxin on the elongation rate of 2-mm sub-apical root segments of *Zea mays* L. cv. Burpee Snowcross were investigated under aerobic and anaerobic conditions using a specially designed apparatus. Parallel studies on the coleoptiles were done for comparative purposes frequently. The growth of both root and coleoptile sections eventually ceases in pH 7.0 citrate-phosphate buffer, but shows an immediate sharp increase when the segments are transferred to pH 4.0. This increase is significantly greater in root than in coleoptile segments. Low pH also increases the growth rate under N_2 conditions. In the presence of O_2 , in roots, auxin depresses the low pH response but stimulates the growth rate at pH 7.0 after a lag period. In N_2 , however, auxin appears to have no effect. Apparently, roots are very sensitive to pH and in this tissue auxin may have two growth regulating effects: 1) depressing growth induced by low pH and 2) increasing the growth rate in high pH conditions.

(112)

Synthetic Activity Following a Light Stimulus in Oocytes of a Marine Hydroid

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It has been reported that oocyte maturation in *Hydractinia echinata* begins about thirty minutes before gametes are shed, and that shedding occurs in response to light following a dark period. In the present study, primary oocytes were tested radioautographically for protein and RNA synthesis under two conditions: (1) continuous light and (2) light following a dark period. The protein labeling pattern was similar in both light-activated oocytes and oocytes maintained in continuous light. Differences were noted, however, in RNA synthesis under the two conditions. Primary oocytes maintained in continuous light incorporated tritiated uridine at a higher rate than did oocytes which had been removed from dark to light. The reduced number of silver grains found in radioautographs of light-activated oocytes was due to major reductions in nuclear counts. RNA synthesis in primary oocytes of *Hydractinia* thus appears to be decreased in response to the light stimulus.

(36)

Germination Variability of Common Purslane (*Portulaca oleracea* L.) Seed

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Germination tests were performed with freshly collected common purslane (*Portulaca oleracea* L.) seed. Seed collected at or after fruit dehiscence germinated poorly or not at all in either light or darkness at a constant 21, 31, or 35 C. Germination was greatly enhanced by a treatment sequence of 15 C in light or darkness followed by 35 C in light. Germinability varied greatly among seed produced in individual fruits on the same plant. Variations were not due to low seed viability or specific locations of fruit on the plant. Immature seed collected prior to fruit dehiscence were less light sensitive and had less specific germination requirements than seed collected after dehiscence. Dormancy developed during seed maturation on the plant. Seed maturity at the time of dispersal may influence germination variability of common purslane.

(130)

Current Status of Several Rare and/or Endangered Species of Tennessee Fishes

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Significant recent information is available concerning the status and present known distribution of *Hemitremia flammea*, *Hybopsis calni*, *H. monacha*, *Etheostoma cinereum*, *E. direma*, *E. tippecanoe*, *E. trisella*, *Percina (Imostoma)* sp., *P. burtoni*, *P. macrocephala*, and *P. squamata*. The status of several undescribed species that are considered to be rare and/or endangered will be considered pending approval by the prospective authors of these species. The available information for the following species is briefly men-

tioned, although no contributions can be made to our current knowledge concerning their status: *Lagochila lacera*, *Fundulus albolineatus*, *Nonurus baileyi*, *N. flavipinnis*, *Etheostoma acuticeps*, *E. tuscumbia*.

(318)

Additions to the Fern Flora of Mississippi

A. MURRAY EVANS, The University of Tennessee

In compiling data on the pteridophytes for the Mississippi flora project, a number of new records for the state have been accumulated since Jones, Pullen and Watson published their checklist in 1969. These new records are discussed with a discussion of further distributions which would be expected and additional taxa which might be expected to occur within the state but have not as yet been observed.

(322)

An Ecological and Floristic Study of South Florida Vegetation Extending from Biscayne Bay Through the Limestone Coastal Ridge

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University of Miami

The study area consisted of a strip of land approximately 200 meters wide by 1300 meters long. The study was carried out qualitatively by intensive transects and quantitatively by the use of 5 x 20 meter quadrats. Analysis indicated that within this region there are six vegetational communities ranging from the mangal through dry pineland on the limestone coastal ridge. The communities were analyzed statistically as well as for their temperate, tropical, introduced, and endemic components. This analysis pointed up the importance of the invasion of introduced species. (Research supported in part by the National Science Foundation through the 1971 Advanced Seminar in Tropical Botany held at the University of Miami.)

(227)

Pesticide Toxicities and Interactions in Neonatal Rats

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University of Alabama

The widespread occurrence of persistent pesticides in the environment is well documented. There is, however, a substantial void in information on the interactive effects of these agents in neonatal animals. In this study, aldrin, dieldrin, chlordane, and DDVP were dissolved in corn oil and administered at various concentrations and combinations to neonatal Sprague-Dawley rats by stomach tube. Daily weight gain, mortality, liver:body weight ratios, and blood chemistry were monitored. LD₅₀ values and toxicity levels for all agents were determined when pesticides were administered as a single agent or in combination with other pesticides. The results demonstrated an increased susceptibility of young animals to these pesticides as compared to adults and that the toxic effects of dual pesticide combinations, simultaneously administered to neonatal animals at sublethal doses, were greater than when either pesticide was given as a single agent. In addition, single sublethal doses of pesticides, administered to one day old animals, increased their susceptibility to sublethal doses of other pesticides administered at 14 days of age.

(6)

Interspecific Modeling and Variation in Mammalian Water Consumption

MICHAEL P. FARRELL, *Mississippi State University*

Ad libitum water consumption of 115 cotton rats (*Sigmodon hispidus*) over a 45 day period exhibited a negative correlation with body weight. While no significant sexual differences were found, age-specific differences in water consumption exist. Sub- and young-adults had similar values, which were greater than old-adults. Age class variances were homogeneous and showed a positive semi-logarithmic correlation with mean body weight of the class. Similarly, the coefficients of variation increased positively with age but were logarithmically related to mean body weight. Further analysis of variation in water intake as a function of 10 g increments in body weight showed heteroscedasticity. No correlation was found between body weight and variance.

Logarithmic analysis of interspecific differences in water consumption substantiates, in part, the model of Chew (1965), i.e. liters consumed/day = $0.98 \text{ kg}^{0.166}$. Residual analysis and normal deviate calculations permitted determination of "outlying" species. Application and importance of variation and residual analysis are discussed in relation to water consumption and other aspects of mammalian water metabolism.

(253)

Developmental Studies with Temperature Sensitive Mutants of *Drosophila melanogaster*

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Experiments on the developmental time of action of conditional lethal mutations have been carried out, using ethylmethanesulfonate-induced temperature sensitive (*ts*) mutants located on the *Drosophila* third chromosome. By daily shifting synchronized cultures from restrictive to permissive incubation temperatures, or *vice versa*, the beginning and duration of the temperature sensitive period (TSP) have been defined for nine different *ts* mutants. The TSP is believed to represent the time interval during which an essential, transient, thermolabile gene product is required for normal development. In the mutants studied the TSPs discovered vary with respect to their onset and duration. However, the stage at which death actually occurs at the restrictive temperature may either immediately follow the TSP or occur considerably later in development. Several of the mutants studied offer the opportunity to investigate specific biochemical events associated with development.

(199)

Effects of Radiation and Oxygen Stress On An Aquatic Microecosystem

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The effects of ionizing radiation and oxygen stress on population density, net production and primary productivity of clonal strains of an ostracod (*Cypris virens*), a copepod (*Cyclops viridis*), the algae *Engelma* and *Chlamydomonas* and an aquatic plant, *Anacharis* grown together in an aquatic microecosystem were studied. The

experimental organism were cultured under oxygen stress from 2 ppm to saturation and irradiated with sublethal LD₅₀ doses of ⁶⁰Co gamma radiation.

Experimental design consisted of microecosystems which were irradiated both prior to and during oxygen stress. Evaluation of population density, net production and primary productivity were determined using direct microscopic counting of organisms, extractable chlorophyll production and NaH¹⁴CO₃ uptake. These effects were monitored periodically over an eight week period.

(116)

Comparative Underwater Survival of Seven Species of Mississippi Turtles (Order Chelonia, Class Reptilia)

BARBARA A. FISCHER, *University of Southern Mississippi*

Seven species of turtles from southern Mississippi when kept completely submerged at 22°C had mean species survival times ranging from 12.5 hours to 26.6 hours. Statistically significant differences in survival times were found between many pairs of species. The mean survival time of the males was very significantly longer than the corresponding females in two species (*Trionyx spinifer asper* and *Pseudemys scripta elegans*). It is suggested that a variety of factors may explain the differential abilities among species and between sexes to remain alive for extended periods underwater.

(259)

Use of Mate Discrimination Tests in the Systematics of Livebearing Mexican Fishes of the Family Goodeidae (Atheriniformes, Osteichthyes)

JOHN MICHAEL FITZSIMONS, *Louisiana State University*

Mate discrimination tests with goodeids of the genera *Xenotoca* and *Characodon* indicate that their discriminatory ability is an inherited trait requiring little or no specific learning for its phenotypic expression. Fishes raised in complete isolation and those with only heterospecific experience readily selected the conspecific mate when available. Observations of mate discrimination in the F₁ hybrids, which showed nearly equal attention in courtship to both parental types, provide further support of a genetic basis for this behavior. Courtship discrimination tests complement other data that indicate the specific identity of *Characodon lateralis*, *Xenotoca variata*, *X. ciseni*, and a new dark-bodied species of *Xenotoca*. Evidence for the perfection of premating isolating mechanisms in sympatry is seen in the results of interspecific and intraspecific discrimination tests, in the response of the parental species to the F₁ hybrids, and in the response of the hybrids to the parental forms. Test data indicate that females are subjected to more intensive selective pressures for mate discrimination.

(120)

Characters of F₁ Hybrid Frogs Between Six Species of *Hyla* (Amphibia: Anura)

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Characters of F₁ frogs (4-7 months) were studied from 10 crosses involving *Hyla cinerea*, *H. avivoca*, *H.*

gratiosa, *H. chrysoscelis*, *H. femoralis* and *H. squirella*. The *H. cinerea* lateral stripe appeared in all offspring of *H. cinerea* × *H. gratiosa* and *H. cinerea* × *H. squirella* but was not present in the *H. cinerea* × *H. chrysoscelis*, *H. cinerea* × *H. avivoca* and *H. cinerea* × *H. femoralis* offspring. The yellow thigh spots of *H. femoralis* appeared in offspring of *H. chrysoscelis* × *H. femoralis* and *H. femoralis* × *H. squirella*, but not in *H. cinerea* × *H. femoralis*. The light eye spot in *H. chrysoscelis* and *H. avivoca* were present in all hybrids involving one or both of these parents. The green thigh color of *H. avivoca* was indicated in hybrids of *H. avivoca* × *H. chrysoscelis* and the reciprocal, but the yellowish-orange thigh of *H. chrysoscelis* was not. The dorsal spots of *H. gratiosa* were found in all hybrids of *H. cinerea* × *H. gratiosa*.

(293)

Development of Primary Root Tissues in *Strophostyles helvola* L. (Dicotyledonae: Rosales: Fabaceae)

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Strophostyles helvola L. is a trailing vine common in damp thickets and shore areas of much of the eastern United States. It is especially abundant on the dunes of the coastal fringe of North Carolina. Because of the harsh environment of the dunes, development of the root tissues is of interest. During development the root forms aerenchymous tissue in the cortex and large lysogenous cavities in the xylem shortly after the differentiation of the first vessels. Nodules containing nitrogen fixing *Rhizobium* appear in clusters near the base of the root when the plant is two to three weeks old. Other specific developmental features of the root system will be described.

(157)

Apparent Free Space in Excised Segments from Different Regions of the Corn Root

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An accurate method was developed for determining the apparent free space (AFS) of corn root segments using ⁸⁶Rb. Segments from 3 regions were capped with wax to prevent movement of ions directly into the stele. Absorption and desorption solutions were aerated. A rinse lasting 0.20 min with cold distilled water before desorption adequately decontaminated the surface film without removing ions from the AFS itself. Desorption solutions were maintained at 12°C to prevent accumulation of ⁸⁶Rb by the segments.

The AFS of root segments from solution-grown plants was as follows: apical, 17.7%; median, 16.9%; and basal, 15.4% of total segment volume. These results suggest direct correlation of AFS and active accumulation. Root segments from plants grown in moist chambers contained AFS comparable to those grown in solution. Fluctuations in measured AFS were greatest in basal segments. Anatomical studies revealed features which could increase the measured AFS of all segments, especially basal ones. Branch root primordia were present in one-fourth of the basal segments examined. Inter-cellular spaces were present in all segments, and they increased basipetally in size, accounting for from 5% to 50% of the total root volume.

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(156)

Water Potential Measurement of Intact Roots EDWIN L. FISCUS, Duke University

A technique is presented for measuring the water potential of intact growing roots. Measurements are made by attaching a Peltier-effect thermocouple psychrometer to the root in such a way that the root passes through the teflon psychrometer chamber. Ambient soil or solution water potential may be measured simultaneously with a ceramic cup psychrometer. Both soil and root psychrometers were calibrated over the expected operating ranges of temperature and potential. Data obtained from sand grown corn plants are presented.

(38)

Response of Young Citrus Trees to an Imposed Magnetic Field

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The stems of young sour orange seedlings were encircled with copper wire, coils, 5 cm. diam. by 9.5 cm. long. Electric current to the coils was adjusted to provide two field strengths, two magnetic pole orientations and continuous or intermittent fields. Data taken included growth measurements, mineral analysis of the leaves, degree of insect infestation, and other visual observations. The treatment period was from November 1968 to August 1969. Leaves of trees in the magnetic field showed greater visual deficiency symptoms compared to control trees. In late February bulbous, tumor-like growths appeared on the stems of some treatment trees at a point of greatest concentration of the magnetic lines of force. Within two months the tops of six of these affected trees had died. The magnetic field had no consistent effect on mineral nutrition. Tree mortality and the pattern of insect infestation suggested the treatments might have disturbed synthesis or movement of organic compounds.

(301)

The Allelopathic Influence of *Sassafras albidum* on Old Field Succession

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Sassafras albidum is a common constituent of successional old field communities in Tennessee, occurring in almost pure stands from early seral stages into the mature deciduous forest. The reported presence of known inhibitory compounds in various organs of sassafras suggested the existence of an allelopathic interference mechanism.

Several phytotoxic compounds namely, d-camphor, citral, euganol, α-phellandrene, 2-pinene, and safrole, were isolated from canopy washings, litter, roots and soil cores taken within sassafras stands. Seed germination and radicle growth of selected test species were generally inhibited when treated with aqueous leachates of leaves, litter, and canopy washings. Seeds germinated on soil discs obtained beneath sassafras stands and seeds overwintered in sassafras litter demonstrated statistically significant reductions for most test species. Results indicate that many modes of phytotoxin release were in operation during various times of the year continually influencing the surrounding environment.

(3)

The Relationship Between Age of Grouping
and Open-field Behavior of the Prairie
Deermouse, *Peromyscus Maniculatus* Bairdii.
(Mammalia; Rodentia)

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At weaning prairie deermice were placed into bisexual groups of ten mice each, held as bisexual pairs and later grouped, or held as bisexual pairs until sacrificed. Mice from all groups were individually tested on an open-field, sacrificed and autopsied at twenty day intervals until 100 days of age.

The open-field was a circular structure with five juvenile mice caged in the center. Latency (time to enter the field), total activity (the number of lines crossed), the number of entrances into the circle closest to the caged young mice (the inner circle) and the time spent in the inner circle were measured during the five minute test.

Analysis of variance and covariance indicate that a complex relationship exists between these behaviors, the treatment the animals received, age at death and endocrine organ weights. The possible importance of these findings to the population dynamics of *P. m. bairdii* is discussed.

(229)

Single Neuron Activity in the Medulla Oblongata
of Decerebrate Cats in Response to Peripheral
Painful Stimulation

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Response characteristics of single neurons in the medial portion of the reticular formation of the medulla were recorded extracellularly in un-anesthetized, decerebrate cats immobilized with Gallamine. Electrode tracts were confirmed histologically. Peripheral electrical stimulation consisted of a supramaximal pulse train of 250-500 msec. at a frequency of 50 Hz., applied to foot pads. Physiological stimulation consisted of touch, hair and joint movement, deep pressure, and pinch sufficient to elicit limb withdrawal. Neuronal responses were recorded on tape for computer analysis. Neurons with spontaneous activity of 0 to 25 impulses per second were encountered which responded to more than one modality. The response to painful stimulation, however, was characterized by a short latency increase or decrease in background firing rate, followed by a prolonged afterdischarge of 1.5 to 12 seconds. With repeated painful stimulation, some neurons showed progressive prolongation to their afterdischarges (wind-up effect). Nonpainful stimulation did not evoke afterdischarges or decreases in firing rates.

(96)

Haemocyte Function During Ecdysis by the
American Cockroach *Periplaneta americana* (L.)

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The total number of haemocytes or blood cells increases markedly during the premoult period. During and after ecdysis the number of cells declines. This decrease is thought to be due to the loss of blood volume brought about by the secretion of a diuretic hormone. It has been found that a number of important biochemical reactions occur in these cells and that some protein synthesis takes place as well. Preliminary investigations have shown that various blood proteins are incorporated into the exoskeleton and that these proteins are "sclerotized" by cross-linking diphenols. Evidence is presented that the blood cells are responsible for the formation of the diphenols and at least part of the proteins. The significance of these findings are discussed in regard to the molting process in cockroaches.

(148)

Cesium Contamination of a Fresh Water Creek
and Its Floodplain

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Radioactive cesium released from a production reactor over many years has accumulated in the sediments and vegetation of Steel Creek on the Savannah River Project. Levels of contamination vary in different soil types. There was also significant interspecific differences in the amounts of ¹³⁷Cs in the dominant plant species. The distribution of cesium in the plant parts will also be discussed.

(215)

Effects of Shading on the Migratory Behavior
of the Migratory Behavior of the Florida
Harvester Ant, *Pogonomyrmex badius* (Insecta:
Hymenoptera: Formicidae)

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Shading of the mound surfaces of a series of *Pogonomyrmex badius* colonies caused an increase in the number of seasonal migrations to new colony sites. All of the treated colonies (N=15) moved at least twice, while only 53.3% of the control colonies moved once. The shaded colonies moved an average of 4.5 ($\pm 0.5SE$) times per colony. One colony moved 9 times. The shading caused a reduction in soil temperature to a depth of 50 cm. It is speculated that the reduction in soil temperature interfered with the normal development of the brood and the colonies' response was migration to a new site. Since it invokes a predictable response, shading may be an excellent tool for future experimental studies into the behavior of *P. badius*.

(17)

Geographical Variation in Reproductive Attributes in the Mud Turtle *Kinosternon subrubrum* (Reptilia, Chelonia, Kinosternidae)

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AND
University of Georgia

Clutch size, size at maturity, and sexual dimorphism were found to vary over the range of the mud turtle, *Kinosternon subrubrum*. This variation is discussed in the context of the ecological and evolutionary significance.

(304)

Relating Forest Vegetation To Site Characteristics In the Central Great Smoky Mountains

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Quantitative relationships among site variables and forest community characteristics were sought using data from 283 one-fifth acre samples in the central portion of the Great Smoky Mountains National Park in eastern Tennessee and western North Carolina. For each tree taxon in each sample, relative density (based on stems per acre), relative basal area and an importance value were computed. Multivariate analytical techniques were applied to the problem of relating site characteristics to vegetation. Site variables included potential solar irradiation, hours of sunshine lost by topographic shading, elevation, aspect, slope angle, topographic position and shape, and soil characteristics.

(42)

Isoperoxidases of IAA Oxidase in Oat Coleoptiles

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A crude enzyme preparation was obtained from eight-day old etiolated *Avena* coleoptiles. The crude preparation was lyophilized and then separated by the disc method of polyacrylamide gel electrophoresis. Eight isoenzymes were revealed with five obtained from anodic separation and three isoenzymes obtained from cathodic separation.

All isoenzymes were shown to possess peroxidative activity by staining and three of the isoenzymes were shown to possess oxidative as well as peroxidative activity. Bioassay demonstrated that the cathodic isoenzymes possessed greater enzymic activity than anodic isoenzymes and two anodic isoenzymes were shown to lack IAA oxidase activity.

Treatment of coleoptiles with IAA resulted in repression of two anodic isoenzymes possessing only peroxidative activity and all anodic isoenzymes possessing oxidative activity. However, the same treatment of coleoptiles resulted in induction of two new cathodic oxidase isoenzymes.

(308)

Nitrogen Fixation in Salt Marshes Near Pensacola, Florida

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A year-long survey of nitrogen fixation was made in two salt marshes in the Pensacola, Florida region. At two week intervals samples of salt marsh materials and organisms were tested for nitrogen-fixing ability utilizing the acetylene reduction method. The materials regularly tested included living *Spartina* and *Juncus*, dead *Spartina* and *Juncus*, and surface (top cm.) mud and water from the *Spartina* and *Juncus* zones. The *Cladium* and mixed grass zones were spot checked for nitrogen-fixing abilities, as were two small vascular hydrophytes and shells of ribbed mussels and marsh snails. Dead leaves and stems of *Spartina* and *Juncus* exhibited highest abilities to reduce acetylene; surface mud from both zones and live stems of both species showed some nitrogen-fixing ability; water and other materials tested seldom reduced acetylene. Microorganisms responsible for these results include *Rhodopseudomonas*, *Rhodospirillum*, *Anabaena*, and *Lyngbya*.

(145)

Preliminary Investigations of Ecosystem Dynamics in the Dog River

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The Dog River is an urban river draining Mobile, Alabama. It flows into Mobile Bay and exhibits tidal fluctuations for most of its length.

As exploratory investigations leading to possible species diversity studies, preliminary examinations of physical factors and indicator species have been made.

Physical factors so far investigated include dissolved oxygen and carbon dioxide content, salinity, nitrate, pH, and temperature at selected depths. Abundance of *Euglena oxyuris* has been determined at sampling stations the length of the river.

Oxygen and salinity increased toward the mouth of the river, carbon dioxide decreased, and nitrates are strongly influenced by location of the sewage plant. Quantitative measurements of *E. oxyuris* have proved to be related to several abiotic factors.

(263)

Toxicity to *Salmo gairdneri* Richardson (Osteichthyes, Salmoniformes, Salmonidae) of Waste Liquor From a Neutral Sulfite Pulpmill

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Static bioassays with neutral sulfite waste liquor and young *Salmo gairdneri* were conducted. The composition of this effluent as well as the LC₅₀ varies. In two experiments the 96 hr. LC₅₀ was greater than 1.0%, above the test concentrations used. In three experiments the mean 96 hr. LC₅₀ was 0.44%. No mortality occurred beyond the first 24 hours. It appears that fish exposed to this material have an increased respiratory rate, elevated red and white blood cell counts, hematocrit, and hemoglobin. Some behavioral and organ changes were noted. The data suggests that these fish

are either able to acclimate to sublethal concentrations or the toxicity of the effluent decreases during the 96 hr. bioassay.

(171)

Steryl Glycoside Synthetase in Tobacco Seedlings

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Steryl glycosides were isolated from 6-day old tobacco seedling and the major sterol components were sitosterol, stigmasterol, campesterol and cholesterol. Steryl glycoside formation occurred readily upon the addition of labeled free cholesterol to the crude extract, and it was the 20,000 × g fraction which showed the highest enzyme activity. At an optimum pH of 7.4, it was found that cholesterol-4-¹⁴C incorporation into the glycosides required ATP, and it was slightly inhibited if UDG was added. The rate of steryl glycoside formation was linear till 50 to 60% of the added radioactive cholesterol was converted, however, the reaction continued until 70-80% was in the glycoside form. Using a GLC procedure it was found that for steryl glycoside formation the endogenous free sterol was as readily available as the added cholesterol-4-¹⁴C. Furthermore, results indicate that steryl glycoside formation is more rapid from sitosterol than from cholesterol.

(62)

Lignification as Related to Salinity in *Salicornia virginica* L. (Dicotyledonae: Chenopodiales: Chenopodiaceae)

WILLIAM B. GURLEY AND CHARLES E. ANDERSON
North Carolina State University

Seedlings and cuttings of *Salicornia virginica* L. were grown in sand, and watered three times daily with Hoagland's solution. The NaCl content of the Hoagland's solution ranged from 0% to 4%. Lignin determinations, phenylalanine ammonia lyase assays, and sodium determinations were made for each of the salinities using 5mm shoot tips. The possibility that changes in NaCl levels are related to variation in lignification patterns via an adjustment in phenylalanine ammonia lyase activity will be discussed.

(81)

Annual Changes in the Population Size Structure of *Penaeus setiferus* (Crustacea, Decapoda, Penaeidae)

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OLGA P. HACKNEY
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The population size structure of *Penaeus setiferus* in and around the Altamaha estuarine system was examined in monthly intervals from Jan. 65 through Dec. 70. Recruitment of smaller individuals was noted as were deviations from expected patterns. An attempt was made to correlate some of these deviations with physical parameter changes.

(104)

Observations on the Ultrastructure of *Aspergillus clavatus*

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Aspergillus clavatus is a common soil fungus belonging to the order Moniliales of the Fungi Imperfecti. The species is characterized by the possession of a large clavate vesicle bearing masses of conidia and by the production of a strong, unpleasant odor. The vesicle is covered by specialized cells, the phialides, which produce the conidia. Phialide formation occurs over the surface of the vesicle at points where thin areas develop due to partial dissolution of the vesicle wall. The thin wall remaining then pushes out from the vesicle to form the phialide. As the phialide matures it tapers at the apex to a narrow neck with a thickened collar. Conidial development is phialogenous, with young conidia pushing out of the apex of the phialide, then being cut off by septum formation. The conidia form in chains, with the youngest conidium at the base of the chain. (This research was supported in part by National Science Foundation Grant No. GB-28666X.)

(193)

Effects of a Nutrient-enriched Stream on Phytoplankton Carbon Fixation in a Bayou Estuary

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Certain aspects of Carpenter's Creek entering Bayou Texar, Pensacola, Escambia County, Florida, are being studied in relationship to carbon fixation by the bayou phytoplankton. Spatial and temporal variation of surface primary productivity estimations are being made at stations ranging in location from the creek entrance into the bayou, to the opening of the bayou into Pensacola Bay. Spatial trends indicate higher rates of carbon fixation at stations where creek water mixes with bayou water. Seasonal trends indicate higher production rates in summer and early fall.

In situ culture experiments involving 14-Carbon technique are being employed to evaluate the specific effects of creek water on the primary productivity of the bayou. Using the same techniques, the effects of nutrient solutions, containing equivalent amounts of inorganic nitrogen and phosphorous as those found in the creek, are being determined. The results of these experiments are now being evaluated in the light of complex synergistic effects involving other parameters. In general, however, the data does suggest that major nutrients (ammonia, nitrate, phosphate) are not always limiting factors in the primary productivity of the bayou.

(123)

A Report on the Ichthyofauna of the Amazon River at Puerto Nariño, Colombia

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Studies on the ichthyofauna at Puerto Nariño, Colombia began in June, 1971, followed by another expedition in January, 1972. The teleostean freshwater fishes (except the catfishes) collected during the expeditions are briefly discussed.

(101)

Morphogenesis and Fine Structure of the Synnema of the Ascomycete *Ceratocystis ulmi*

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The synnema is an erect bundle of hyphae terminated by a mass of asexual spores. Techniques of scanning electron microscopy, transmission electron microscopy of thin sections and freeze-etch replicas, and chemical analyses of cell walls have been used to characterize the changes which occur in the development of the synnema of *Ceratocystis ulmi*, the fungal pathogen responsible for the Dutch elm disease. Cross connections between parallel hyphae and an interhyphal slime layer stabilize the synnema form. Vegetative hyphae differ in their wall structure from those hyphae comprising the synnema. Synnema conidia walls differ in staining characteristics from either vegetative or synnema hyphae. Storage granules of lipid are present in conidia but are not common in hyphae grown under the conditions employed. Vegetative hyphae and conidia contain organelles typical of most fungal cells but a loss of intracellular integrity occurs in maturing synnema hyphae as spores are produced at the apex.

(111)

Histochemistry and Preliminary Electron Microscopy of Early Gemmule Development (Porifera: Spongillidae)

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NORIMITSU WATABE, *University of South Carolina*
RICHARD M. DILLAMAN, *University of South Carolina*

Gemmule formation in the freshwater sponge *Corvomeyenia carolinensis* Harrison is initiated by the aggregation of non-archeocyte ameboid cells. These cells are characterized by chemically complex cytoplasmic inclusions composed of PAS-positive primarily non-glycogenic carbohydrate, non-histone protein, and acid mucopolysaccharide. Cytoplasmic RNA is sparsely distributed between the non-osmiophilic inclusions. The nucleolate nucleus is Feulgen-positive. Preliminary electron microscopic observations show that the electron-opaque cytoplasmic inclusions are surrounded by membrane systems (possibly agranular endoplasmic reticulum). These membranes may penetrate into the inclusion core. The inter-inclusion cytoplasm often contains a well defined granular endoplasmic reticulum. This is perhaps continuous with the membranes of the agranular endoplasmic reticulum. These aggregating cells bear no resemblance, histochemically or ultrastructurally, to the archeocyte cell type. Archeocytes are classically considered to form spongillid gemmules. Archeocytes, easily recognized by their large nucleolus, RNase-labile cytoplasmic basophilia, and prominent granular endoplasmic reticulum, are not involved in early stages of gemmule formation in this species.

(25)

Patterns of Occurrence of Reef Fishes in the Northern Gulf of Mexico

ROBERT W. HASTINGS, *Florida State University*

Numerous papers have reported the seasonal occurrence of marine reef fishes (often referred to as "tropical fishes") in inshore waters of the northern Gulf of Mex-

ico. Two theories have been suggested to explain the occurrence of these fishes in the northern Gulf: (1) summer recruitment of pelagic eggs and larvae carried northward by currents from the Caribbean region (Stragglers); and (2) existence of permanent populations on offshore reefs in the northern Gulf (Residents). Both theories are apparently valid, and certain species can be assigned to each category. The second group can be divided into two subgroups: (a) inshore species, which are common inshore during the spring, summer, and fall; and (b) offshore species, which rarely, or never, occur inshore. Species of the families Chaetodontidae, Pomacentridae, and Labridae are used to exemplify each group.

(154)

Dynamics of Diamorpha Systems on Granite Outcrops

JOHN DUV. HAY, H. L. RAGSDALE, AND DONALD J. SHURE
Emory University

Granite outcrops offer unique possibilities for ecological systems analysis due to the discrete distribution of ecosystems over the exposed granite. Studies of intra- and intersystem material flow through Diamorpha systems have been initiated on the Rock Chapel Granite Outcrop, Rock Chapel, Georgia. Intrasystem parameter analysis includes: litter decay rates, soil microarthropod densities, soil organic matter content, soil exchange capacity, and animal activity in the system. Intersystem parameter analysis considers: outcrop temperature variation, wind, humidity, insulation, rainfall, system inputs by rain or wind, system exports by rain or wind, and transient animal effects. The results include graphical analysis of an annual cycle of biotic and abiotic parameters and a qualitative model of intra- and intersystem material flow.

The term Diamorpha is used in reference to the system type, rather than to the specific organism involved.

(132)

The Reproductive Biology of the Longnose Shiner, *Notropis longirostris* (Cyprinidae), in Mississippi

DAVID C. HEINS AND GLENN H. CLEMMER
Mississippi State University

The reproductive biology of *Notropis longirostris* (Hay) in Catahoula Creek, Hancock County, Mississippi, was studied from December 1970 through December 1971. Numerous spawnings occurred from April through October. Females produced a small number of mature ova prior to each spawn. The prolonged spawning season is suggested to have survival value in a habitat characterized by a shifting sand bottom and extreme fluctuations in water level and flow rate.

(68)

Preliminary Results of Eutrophication Studies on Smith Mountain Lake

ALBERT HENDRICKS AND FRED BINFELD
Virginia Polytechnic Institute and State University

A primary productivity study was begun on Smith Mountain Lake in August 1971. The objective of this study is to determine the various trophic levels of the

reservoir. The water in the Roanoke Arm of the reservoir is highly enriched while the Blackwater Arm is rather oligotrophic. A series of nine stations were established, one on the Blackwater Arm, five on the Roanoke Arm, one at the confluence and two between the confluence and the dam. The following parameters are being considered: C-14 assimilation, chlorophyll *a* concentrations, phosphate and nitrate concentrations, light penetration, temperature profiles and dissolved oxygen. From these tests we have found the following: C-14 assimilation approximately twenty times greater at the upper Roanoke Arm station than the lower station. Chlorophyll *a* approximately five to six times greater, light penetration three to four times less, and nitrate and phosphate concentrations twenty times greater. This work was supported by Appalachian Power Company.

(289)

A Broader Application for 4½ Clearing Fluid

J. M. HERR, JR., *University of South Carolina*

The clearing-squash procedure previously devised for investigation of ovule and megagametophyte development in angiosperms has been modified and more broadly applied to the study of diverse structures throughout the vascular plants. In the original procedure, material to be studied was fixed in FPA₅₀, stored in 70% ethanol, and then treated for twenty-four hours in 4½ clearing fluid (lactic acid, chloral hydrate, phenol, clove oil, and xylene; 2: 2: 2: 2: 1, by weight). Specimens so treated were mounted on slides beneath supported cover glasses and examined at selected focal planes with phase contrast optics. Nomarski interference optics have recently been applied, and in some cases prove superior to phase contrast microscopy. A modification of the clearing fluid by the addition of 100 mg iodine and 500 mg potassium iodide to 9 gms of the original mixture has been introduced primarily to enhance the phase contrast image of treated material. This modified fluid also permits the detection of accumulated starch. The study of internal structure from optical sections of various cleared specimens examined with phase contrast, Nomarski interference, and dissecting microscopes has proved successful. Recent investigation has been directed to the apical meristem of *Marsilea* sp. roots, meiosis in *Psilotum nudum* (L.) Beauvois, stem structure in *Equisetum hyemale* L., the free nuclear megagametophyte in *Pinus palustris* Miller, and vascular distribution in *Psilotum nudum*, *Ophioglossum* sp., and *Zamia integrifolia* Ait.

(11)

Faunal Fluctuations in Enriched Process Waters

EDWIN E. HERRICKS, *The Johns Hopkins University**

A process water pond of the Black and Decker Company, Hampsted, Maryland was studied to note the fluctuations in faunal populations due to environmental changes and population interactions. In situ and laboratory experiments were carried out using the enriched pond waters. The results show free swimming *Rotatoria* were concentrated near the thermocline; 4 org./ml. @ surface, 128 org./ml. @ 7 ft., 1 org./ml. @ 12 ft. *Cladocera* and *Copepoda* showed diurnal movement through the water column governed by temperature with greatest concentrations in cooler water. Experiments were performed to note the effect of successional changes and predator stress on algal and protozoan populations.

Laboratory aquaria maintained under seasonal lighting conditions showed decreased oxygen production 85% vs. 120% saturation, and decreased chlorophyll-*a* concentrations .03 ppm vs .10 ppm under heavy predator stress. When conditions were changed from fall temperature and photoperiod to summer temperature and photoperiod populations showed a shift to summer dominance. Stabilization of conditions produced a low diversity. This work was supported by the U. S. Public Health Service, Environmental Biology Training Grant.

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(69)

The Recovery of Stream Macroinvertebrate Communities From the Effects of Acid Mine Drainage

EDWIN E. HERRICKS AND JOHN CAIRNS, JR.
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Indian Creek, Fayette County, Pennsylvania was studied to note the effects of acid mine drainage on aquatic macroinvertebrate communities. Indian Creek receives one major acid discharge and several minor seepage discharges in its upstream region. Reference stations showed a high diversity, $\bar{d}$ 3.2 and above. Diversity was depressed by the acid drainage; mid-portions of the stream had $\bar{d}$ values in the range of 1.8 to 2.8. Eight miles below the drainage region aquatic communities had recovered with $\bar{d}$ values greater than 3.0. The effect of the acid drainage varied with stream discharge. Low flow conditions in mid-summer showed a downstream shift in the effects of the acid drainage. Increases in $\bar{d}$ occurred after the confluence with unpolluted tributaries. The tributaries had the dual effect of improving water quality either by dilution or chemical reaction, and supplying organisms for the recolonization of damaged sections of the stream. The major mechanism of recolonization seems to be the downstream drift of organisms.

This work carried out with the support of the Office of Water Resources Research and Virginia Polytechnic Institute and State University Water Resources Center, Grant #B-034-Va.

(226)

Camptothecin Metabolism *In Vivo*

H. G. HODO, III AND B. G. MOORE
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Camptothecin (NSC#94600) is a promising antitumor agent which substantially inhibits DNA, RNA, and protein synthesis in L-1210 leukemia cells *in vivo*. Camptothecin was rapidly absorbed by the kidneys, livers, and spleens of leukemic BDF₁ mice following intraperitoneal injection. At later times, camptothecin occurred in the intestinal tract and urine of these animals. Chromatography of organ and tumor cell extracts showed that camptothecin was converted *in vivo* to at least three fluorescent compounds, one of which was hydroxycamptothecin. At all times investigated, these compounds were only associated with L-1210 cells, the intestines, urine, and feces. Hydroxycamptothecin was only found in the feces and large intestine. This finding suggests that the hydroxylation of camptothecin is microbial in origin. The conversion of the drug to metabolites may also indicate that "activation" mechanism(s) are involved in the antitumor properties of camptothecin.

(224)

Erythropoietic Responses of Cholesterol-, Pregnenolone- and Progesterone-Treated Mice

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University of North Carolina at Charlotte

Adrenal cortical secretions are known to influence variably red blood cell production and release, i.e., erythropoiesis. Cholesterol, pregnenolone and progesterone are among precursor substances to these final secretory products. This study reports the effects of these progenitors on erythropoiesis. Mice received pharmacological doses of cholesterol, pregnenolone or progesterone. At selected intervals, experimental and control mice were injected with radioactive iron (^{59}Fe) citrate 24 hours before sacrifice and subsequent determination of ^{59}Fe incorporation into their erythrocytes. For daily samples within a 5 day period following treatment, the mean ^{59}Fe incorporation percentages of control, cholesterol- or pregnenolone-injected male and female mice do not differ significantly. Progesterone administration, however, appears to accelerate erythropoiesis in male mice; data indicate that this effect is manifest on day 4 post-progesterone. No such effect was observed in progesterone-treated females. Grants from the North Carolina Heart Association and the UNCC Foundation are gratefully acknowledged.

(40)

An Autoradiographic Analysis of IAA Transport in Intact Shoots of *Fraxinus americana* L.

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Radioactive IAA, when applied to the terminal buds of intact 3 year old white ash (*Fraxinus americana* L.) shoots was transported basipetally at a rate of 1.3 cm/hr. A microautoradiographic analysis of the transport pathway showed that, at the moving front of activity, the tracer moved primarily in the cambium and adjacent parenchyma of the xylem and phloem. Behind the moving front, the tracer was also observed in parenchyma of the pith, older xylem and cortex possibly as the result of lateral movement.

Following foliar application, labelled IAA was transported basipetally in the shoot at about 4.5 cm/hr. Microautoradiographs from foliar treated shoots showed that the tracer moved, almost exclusively, in the sieve tubes at the moving front. Behind the front of activity, the tracer could be observed in the radial and axial parenchyma of both phloem and xylem as well as in the cambium.

The results of this study indicate that two modes of auxin transport are operative within intact shoots. One mode, basipetal polar transport, apparently occurs between adjacent parenchymatous cells in the phloem, xylem and cambium; whereas, the second is associated with assimilate transfer in the sieve tubes.

¹This work was part of the Ph.D. Dissertation presented, by the author, to the Graduate School, State University of New York, College of Forestry, Syracuse, N.Y. and was supported by funds from the McIntire-Stennis Program.

(223)

Alleviation of Arsenate Teratogenesis in Mice by BAL

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Intraperitoneal injection in pregnant mice of a 40 mg/kg dose of sodium arsenate on gestation day 9 caused increased fetal deaths and decreased weights by gestation day 18 compared with solvent (H_2O) injected controls (29.56% vs 8.82% and 0.78 g vs 0.95 g, respectively). BAL (2, 3-dimercaptopropanol) in corn oil was injected subcutaneously in the nape of the neck. BAL alone had no significant effect ($P>0.05$). Fetuses treated with BAL 4 hr before, concurrently with or 4 hr after arsenate injection did not differ. They exhibited significantly ($P<0.05$) less malformations than those treated with arsenate alone, and more than BAL or control groups. Weights of BAL-plus-arsenate treated fetuses did not differ from those treated with H_2O or BAL alone but were significantly ($P<0.05$) higher than those treated with arsenate alone. Fetal deaths per litter were highly variable and no differences were significant between BAL-treated and other groups.

(245)

Comparative Ultrastructure of Scorpion Spermatozoa (*Vejovis carolinianus* and *Centruroides vitattus*)

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The ultrastructure of the spermatozoa of two species of scorpions, *Vejovis carolinianus* and *Centruroides vitattus* is characterized by atypical patterns of axonemal microtubules. The majority of animal spermatozoa possess a 9+2 or a 9+9+2 pattern of microtubules in the flagellum. *V. carolinianus* sperm flagella exhibit a 9+0 pattern. There are 9 outer doublet microtubules with thick arms extending inward from each doublet, but the usual two central tubules are missing. These sperm possess a complex acrosome containing a subacrosomal rod at the anterior end of the corkscrew-shaped head. The chromatin within the nucleus appears dense and amorphous. The midpiece is characterized by a helical sheath of 5 to 8 mitochondria.

C. vitattus spermatozoa have flagella with 9 peripheral doublet microtubules and a single central one. The acrosome is less complex and the nuclear chromatin is arranged in a honeycomb pattern. The midpiece possesses two mitochondria wrapped in a spiral around the axoneme.

(90)

Excretion Rate of ^{65}Zn by the Pinfish (*Lagodon rhomboides*) in Relation to Metabolism

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The rate of excretion of radioisotopes has been proposed as an indirect method for measuring metabolism

under natural conditions. The method consists of following the rate of excretion of a radioisotope by animals free to move about in large tanks in the laboratory or in cages in the natural environment (conditions or normal metabolism) and comparing it to the rate of excretion by animals confined in their movements (condition of routine metabolism). In our experiments the excretion of ^{65}Zn by pinfish confined in modified respiration chambers was compared to excretion by fish swimming free in a large tank. Under our experimental conditions the excretion rate of ^{65}Zn was not significantly different between fish held in respiration chambers and fish free in the large tank. If excretion of ^{65}Zn is related to metabolism, as proposed, normal metabolism is essentially the same as routine metabolism and not twice the value as reported in the literature.

(52)

The Absolute Efficiency of ^{14}C Detection by High-Resolution Microautoradiography

THOMAS L. HOUSLEY AND DONALD B. FISHER
University of Georgia

A procedure was developed to allow the conversion of grain densities in high-resolution microautoradiographs of ^{14}C -labeled sections to absolute amounts of radioactivity. Thin sections were cut from ^{14}C -methacrylate containing a known amount of ^{14}C per unit volume, and the section thickness was measured in an interference microscope. The sections were covered with stripping film prepared by dipping parlodion-covered slides into Ilford L4 emulsion. Under standardized conditions, uniform emulsion layers about 0.8 microns thick could be prepared. Grains per unit area in the autoradiographs could thus be related to the amount of radioactivity per unit volume in the sections.

(113)

Preliminary Studies on Size Relationships of the Propodial Elements of Turtles (Reptilia: Testudines)

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An investigation was undertaken of the relative size of the humerus and femur 1) when compared to one another, and 2) when compared to age (body size). A total of 114 specimens was examined, representing 2 subfamilies, 4 genera and 4 species. From linear measurements of bodily dimensions, regression analyses with corresponding correlation coefficients were computed. Coefficients of variability (V) were calculated as indicators of morphological variability. Interspecific ontogenetic changes in the humeral/femoral ratios ranged from strong to essentially insignificant statistically, with all correlations (r) with body size being negative. Interspecific ontogenetic changes in the humerus versus body size and femur versus body size ratios ranged from pronounced to statistically insignificant, with all correlations (r) with body size being positive.

A tentative explanation is offered to account for the presence or absence of ontogenetic changes, and the differences in the relative size of the propodial elements to body size in the taxa examined.

(43)

Wound Regeneration, Auxin and Peroxidases in Tobacco¹

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AND

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The kinetics of wound regeneration and peroxidase induction have been studied in the pith of intact tobacco plants (Wisconsin-38). Severing a small portion of the vascular elements leads to the establishment of a wound callus, which later develops into a wound cambium. This is followed by the differentiation of lignified elements which ultimately form organized vascular strands around the wound through the pith. During the same period specific peroxidase isozymes (as detected by starch-gel electrophoresis) appear in a narrowly defined region of the pith next to the wound. These isoperoxidases have not been detected previously in the pith, although they have been found in samples of pith tissue cultured on media supplemented with auxin. Experiments have been conducted in an attempt to clarify the relationships among endogenous auxin levels, auxin transport, isoperoxidases, and wound regeneration.

¹ Research supported by a U.S. National Science Foundation Grant GB-8709 to M. E. Clutter and I. M. Sussex and by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

(271)

A Survey of the Molluscs of the Chewacla and Saugahatchee Creek Drainages in Western Lee County, Alabama (Mollusca: Gastropoda and Pelecypoda)

JOHN C. HURD, *Auburn University*

A molluscan survey was conducted in the Chewacla and Saugahatchee Creek drainages during the period from April, 1970 to June, 1971. Representatives of 24 species were collected (Gastropoda 7 and Pelecypoda 17). The collecting sites were studied and described emphasizing their physiography, geology and substratum. Unnatural factors that might influence mussel and snail distribution were also considered.

(114)

Geographic Variation in ^{90}Sr Body Burdens of Southeastern Turtles

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MARGUERITE M. JACKSON, AND *SKAIDRITE KLEINBERGS
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An investigation was conducted of the amounts of ^{90}Sr in the osseous exoskeleton of turtles in southeastern United States. Eighty-two individuals collected from the states of Alabama, Georgia, and Florida, representing two families, eight genera, and twelve species were examined. Since the turtles were freshly captured from various natural habitats, the radionuclide is presumed to have been incorporated into the shell via the normal food chain route from radioactive fallout. Radiochemical analysis confirmed ^{90}Sr to be the radionuclide present

in the shell. Individuals varied in body burdens of ^{90}Sr from 0 to 228 pCi/g of bone ash. Marked geographic differences in body burdens were found within the same taxon, and a species-specific difference appears to be real in the case of at least one species.

(238)

Macro-Colony Formation in the Blue-Green Algal Genus *Nostoc* in Culture

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Usually, *Nostoc* taxonomy is partly based on characteristics of the macro-colony. Since most of our laboratory isolates were initially obtained from fragmented filaments or spores rather than mature colonies, we have studied colony formative tendencies in these (about 40) strains. Contrary to what is generally believed, many *Nostoc* exhibit consistent and predictable growth patterns in both unialgal and axenic culture. Also, when strains of opposite geographic and habitat derivation are independently placed in the same species by other characteristics, they often develop surprisingly similar colonies. In liquid culture on slowly reciprocating shakers, at least three types of colony development can ensue: (1) artifactitious colonies produced by liquid motion and flask geometry—species exhibiting this type colonial development generally form unstructured mats in stagnant culture and spread unevenly over agar plates; (2) artificial colonies produced by association with compatible heterotrophic flora (usually fungi)—this type of development produces essentially similar colonies under most cultural conditions; (3) actually ordered or structured colonies—whereas exact form will vary with different growth conditions, recognizable colony patterns repeatedly occur.

(126)

A Study of the Fishes of the Elk River Drainage System in Alabama and Tennessee

THOMAS S. JANDEBEUR, *University of Alabama*
HERBERT T. BOSCHUNG, *University of Alabama*

The Elk River system, tributary to the Tennessee River, is located in northwestern Alabama and southeastern Tennessee. A total of 128 collections from 115 stations located throughout the drainage system revealed the presence of 107 species and subspecies in 17 families and 48 genera. The streams within the study area were ordered according to the Horton stream order classification as modified in this paper. Nine broad categories reflected by this classification are established with respect to species occurrence, stream order, stream size, and habitat. Eleven species encountered infrequently during the survey are restricted in their distribution to precise habitats and are endangered by proposed dams on the river proper.

(164)

The Tissue Concentration of Zinc in Relation to Growth, Fruiting and the Resistance of Cotton to Verticillium Wilt

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In a series of experiments cotton plants were grown

in sand and supplied complete nutrient solutions. The Zn content of the solutions was varied from 1 to 625 ppm. In separate experiments the early season night temperature was set at 60°, 66° and 72°F. The growth and fruiting of the plants was determined and the Zn content of the various tissue fractions was measured.

In the low night temperature experiment there was a positive relationship between yield and the leaf concentration of Zn up to 104 ppm. Above that level of Zn in the leave, yield decreased. In the warm night temperature test yield was independent of leaf Zn level.

In both the low and medium night temperature experiments, the incidence of Verticillium wilt was found to be inversely related to the tissue level of Zn provided a threshold value of 40 ppm in the stems and 85 ppm in the roots had been exceeded.

(172)

Lipoxygenase Mediated Pentane Production

ELIZABETH B. JOHNS
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Commercial Soybean lipoxygenase has been found to mediate the production of pentane under conditions of low oxygen tension when linoleic acid is used as the substrate. Pentane production is linear from 4-20 minutes after the initiation of the lipoxygenase reaction and is proportional to enzyme concentration over the range of 12.5 to 112.5 μg of protein. The optimum linoleic acid concentration for pentane production is 2.1 mM and higher concentrations are inhibitory. The pH optimum for pentane production is 9 while lipoxygenase has pH optima at 7 and 9.

Purification of the commercial enzyme on Sephadex G-150 and then on DEAE-Sephadex yields two protein fractions with lipoxygenase activity. One fraction is active at pH 7 but not at pH 9 and produces negligible amounts of pentane. The other fraction has lipoxygenase activity at both pH 7 and 9 and also produces pentane at both pH's.

The significance of these results will be discussed.

(142)

A Preliminary Report on Diseases of North Carolina Coastal Crabs With Emphasis on the Blue Crab, *Callinectes sapidus*

CHARLES A. JOHNSON, III
Duke University Marine Laboratory

A survey was initiated in October, 1971, to study the ecology and life history of protozoan parasites infecting the blood and muscle of *Callinectes sapidus*. Specimens were collected monthly from 35 o'oo to 0 o'oo. During October, November and December the incidence of all parasites was low. Of 400 *C. sapidus* examined: 1% were infected with *Paramoeba perniciosa*, all from high salinity waters; 2% from 1.6 to 17 o'oo waters harbored a microsporidian (*Pleistophora* sp.); 5% were infected with a microphalid metacercaria and a hyperparasite *Urosporidium crescens*. One *C. sapidus* contained a large number of neoplastic cells and the hemocytes of several contained a yet unidentified body. *Callinectes similis*, *Ovalipes ocellatus*, *Portunus spinimanus*, *Portunus gibbesii*, *Arenaeus cribrarius*, *Cancer irroratus*, *Menippe mercenaria*, *Neopanope texana*, *Panopeus herbstii*, *Libinia emarginata* and *Hepatus cpheliticus* were also examined for blood and muscle parasites, all negative except one *C. similis* which was infected with *Paramoeba*

sp. Notes on the life history of several parasites will be presented.

(182)

Floristics of *Eupatoriadelphus* King and Robinson and *Ageratina* Spach (Eupatorieae - Asteraceae) in Virginia

MILES F. JOHNSON, *Virginia Commonwealth University*

The taxonomy, ecology and distribution of the recently described genus *Eupatoriadelphus* and *Ageratina* in Virginia are discussed. The paper presented will be incorporated into the Flora of Virginia now in preparation.

(58)

Effect of Exogenous Sugars on Polysaccharide Secretion in Outer Root-Cap Cells of *Zea mays*

DANIEL D. JONES AND D. JAMES MORRE,
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and *Purdue University*

Sugars supplied to germinating maize seedlings regulated the secretion of polysaccharides by the outer root-cap cells. Glucose, galactose, fucose, galacturonic acid, mannose, arabinose, xylose and rhamnose were found as constituents of the secreted polysaccharide. The polysaccharide adhered to the root tips as a droplet and the size of the droplet was used to quantitate polysaccharide secretion. Sucrose, maltose, lactose, glucose, fructose, fucose, ribose and xylose increased droplet size 1.5-2 fold; whereas mannose increased the droplet size 5-7 fold. The marked effect of mannose on polysaccharide secretion was due to an increased rate of secretion and a longer phase of extrusion of polysaccharide into the forming droplet. In contrast to sucrose, mannose stimulated secretion in a maize variety having a high sugar endosperm. The results suggest that regulation of secretion by mannose was due to an alteration of normal sugar metabolism.

(73)

The Role of Certain Protozoa in Mobile Bay

E. E. JONES, *University of South Alabama*

The protozoa represent the largest group of animals in the foodweb. Because of their position at the base of the pyramid, they play an important role in the conversion of plant protein to animal protein. Kodachrome slides will be used to demonstrate the role of certain species in this process.

Research Supported by: OWRI Grant No. A-021-Ala

(236)

Scanning Electron Microscopy and Freeze-Etching of Fructifications (Peridia, Capillitia and Spores) of Certain Slime Mold Species

HAROLD W. KELLER, *University of Florida*

AND

HENRY C. ALDRICH, *University of Florida*

This is a preliminary study describing the micro-surface details of slime mold fructifications (peridia,

capillitia and spores) utilizing the scanning electron microscope and freeze-etching techniques correlated with standard light microscopy. This survey of spore and capillitial surfaces has revealed for *Perichaena microspora* Penz. & A. Lister and *Badhamia ovispora* Racib. that spore ornamentation, as given in all published sources, is clearly in error. Spores of *B. ovispora* are not smooth as previously reported but are covered with plaque-like protuberances. New peridial characters of taxonomic significance are described and their possible phylogenetic significance discussed for *P. microspora* and *Perichaena vermicularis* (Schw.) Rost.

(83)

Effects of Salinity and Ionizing Gamma Irradiation on the Developmental Stages of *Cyathura polita* (Stimpson), (Crustacea: Isopoda: Anthuridae)

B. J. KELLEY, JR.* AND W. D. BURBANCK
Emory University

The effects of salinity and ionizing gamma irradiation on osmoregulation, development and hatching of the marsupial stages of the isopod, *Cyathura polita* have been determined using embryos in various stages of development. Hatching occurred in salinities of 0, 0.5, 10 and 20 o/oo, but was inhibited by salinities of 30 and 40 o/oo. Development proceeded normally in salinities between 0 and 30 o/oo, but was aberrant in salinities of 0, 30 and 40 o/oo. Measurements of freezing point depressions of body fluid or extra-embryonic fluid showed that embryonic *C. polita* is a hyperosmotic regulator in low salinities (0-20 o/oo), but has varied responses in higher salinities (30 and 40 o/oo), depending upon the stage of development. Radiation is discontinued as an important environmental factor influencing osmoregulation in metanaupliar embryos, since other life functions are more sensitive to radiation damage than the osmoregulation system. Physiological and ecological evaluations are given.

(Work supported by AEC Grant AT-(40-1)-2412, and McCandless Fund, Emory University)

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(280)

Host Specificity of *Conchophthirus* (Protozoa: Ciliata) in Freshwater Unionids with Emphasis on Species Type

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Seven species of Unionids (*Lampsilis dolabraeformis*, *Lampsilis splendida*, *Anodonta gibbosa*, *Alasmidonta arcula*, *Elliptio hoptonensis*, *Elliptio spinosa*, *Elliptio shepardianus*) endemic to the river systems of southeast Georgia were collected and examined for species of *Conchophthirus*, a commensal ciliate protozoan found inside their mantle cavities. All mussels examined were infected, infections ranging from light (less than ten) to heavy (several hundred), depending on the unionid species.

Distinguishing morphological characteristics were used to identify the *Conchophthirus* found. Three species were identified: *Conchophthirus magna*, *C. curtus*, and *C. anodontae*, while a fourth species was found which has not been described. Host specific relationships between unionid hosts and the various species of *Conchophthirus* were also noted.

(221)

The Effect of Pinealectomy on Intestinal Function in the Rat

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Intestinal motility in the mammal is influenced by a number of factors, one of which is apparently the biogenic amine, serotonin. Inasmuch as the highest concentrations of serotonin are reported to be found in such anatomically distinct organs as intestine and pineal, it would seem interesting to determine whether there is a correlation between functions and levels of serotonin in these two locales.

Young Wister rats of both sexes were divided into three groups consisting of (1) controls, (2) sham-operated, and (3) pinealectomized animals. These animals were sacrificed and their guts were perfused at constant temperature in oxygenated Tyrode's solution. Peristaltic activity was then measured using a strain gauge transducer, polygraph, and polar planimeter. The data from these measurements revealed a significant decrease (23-36%) in the intestinal motility of the pinealectomized animals when compared with activity measured in both the control and sham-operated animals.

(178)

An Autoradiographic and Biochemical Study of Fucose and Glucosamine Incorporation into Plant Cells

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Analysis of corn roots supplied with ^3H -L-fucose has shown that a large part of the radioactivity is recovered in fucosyl units of cell wall polysaccharides. Autoradiographic evidence indicates that the synthesis of these polysaccharides takes place largely in the root cap and epidermal tissues. L-fucose-1-phosphate and a nucleoside diphosphate derivative of L-fucose have been identified as metabolites of L-fucose and are possible precursors of polysaccharides.

When ^3H -glucosamine, a possible precursor of the carbohydrate moiety of plant glycoproteins, was supplied to corn roots, autoradiography revealed considerable incorporation of the radioactivity into the cytoplasm of the root cells. A similar experiment using ^3H -glucosamine supplied to sycamore (*Acer pseudoplatanus* L.) cells grown in suspension culture demonstrates incorporation of the label into the cell wall as well as into the cytoplasm. This research was supported by grant GB-23533 from the National Science Foundation to R. M. Roberts.

(139)

Fine Structure of *Haemoproteus columbae* Sporozoites

THOMAS R. KLEI, University of Georgia

Haemoproteus columbae sporozoites possess a three layer pellicle, subpellicular microtubules, anterior polar ring, micropore, free ribosome-like particles, a single irregular mitochondrion, and a large nucleus. The longitudinal subpellicular microtubules vary in length

and are regularly spaced around the cell periphery. The sporozoites possess a microneme system in which one to three micronemes are associated with the outer pellicular membrane at the anterior end. A pellicular cavity is found lateral to the polar ring and adjacent to the inner pellicular membrane. The complex structure of the anterior end which includes the micronemes, the microtubules, and the polar ring might possibly aid in cell penetration. Vesicular invaginations of the inner pellicular membrane are present in the anterior region of the cell. The function of these invaginations is unknown. Spherical osmophilic bodies are found throughout the cytoplasm. The concentration of material in these bodies varies and could possibly serve as a nutrient.

(192)

Limnological Studies on Ross Barnett Reservoir, a Shallow Water Reservoir

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Department of Biology, University of Mississippi

Physico-chemical data are presented for a number of sampling stations on Ross Barnett Reservoir, Mississippi, comprising monthly samples per station from July, 1968 through December, 1971. Turbidity and Secchi disc readings indicate that these waters are clear during much of the summer and fall; turbidity was often less than 5 ppm. The area of the reservoir is 12,545 hectares, average depth is 3 m and water level varies little from the normal level of 296 ft above mean sea level. Thermal stratification is unstable and the hypolimnion poorly defined. Encroachment of both submergent and emergent macrophytes may imply enrichment tendencies in this reservoir, but other factors including plankton diversity and quantity and available nutrients indicate generally low productivity. Major sources of nutrients include a water fowl refuge adjacent to the reservoir and poultry processing plants along Pelahatchie Creek. The Chlorophyta dominated the phytoplankton. Other measurements taken were dissolved oxygen, pH, free CO_2 , alkalinity, color and air temperature.

(187)

Dinebra retroflexa (Vahl) Panzer (Gramineae). A Genus and Species New to the United States

RUSSELL L. KOLOGISKI, North Carolina State University

During a study of the vascular flora of Mecklenburg County, North Carolina, *Dinebra retroflexa* (Vahl) Panzer was found growing in a waste area near U.S. highway 29 in the eastern part of the county. This annual bunchgrass is native to South Africa and southern Asia and to my knowledge has never been reported from the United States. *D. retroflexa* is competing successfully in the old field with many species of our native grasses. Surprisingly it is much more robust than it is in its native habitat. As yet no obvious means by which it could have been introduced has been discovered.

(135)

Observations on the Life History of *Lutztrema monenteron* (Price and McIntosh, 1935). (Trematoda: Dicrocoeliidae)

WAYNE A. KRISINGER AND J. FRED DINTON
Cell and Molecular Biology, Medical College of Georgia

Lutztrema monenteron was recovered from the gall bladder and bile ducts of robins, *Turdus migratorius*, and

mockingbirds, *Mimus polyglottos*, from the Augusta, Georgia area. Eggs from the uteri of adult worms were fed in oatmeal to six species of laboratory raised terrestrial molluscs: *Ventridens intertextus*, *Mesodon thyroideus*, *Mesodon perigraptus*, *Triodopsis carolinensis*, *Deroceras reticulatum*, and *Lehmannia poirieri*. Sporocysts developed only in *V. intertextus*, *D. reticulatum*, and *L. poirieri*, with slime balls containing hundreds of longicercous xiphidiocercariae being expelled by *V. intertextus* after 93 days and *L. poirieri* after 80 days of infection.

A common small millipede (*Dixidesmus* sp.) was found to serve as an experimental second intermediate host. This observation incriminates the diplopods as another group of arthropods capable of serving as second intermediate host for dicrocoeliids. The millipeds fed actively on the slime balls and encysting metacercariae were found in their hemocoel within two days after ingestment of the slime balls.

(129)

Appearance and Distribution of the Named and Unnamed Snubnose Darters (*Ulocentra*), *Etheostoma*, Percidae, Osteichthyes)

ROBERT A. KUEHNE, *University of Kentucky*

Four species of (*Ulocentra*) darters have been described: *Etheostoma antripinnu*, *E. coosae*, *E. duryi* and *E. simoterum*. But there seem to be six additional forms in Kentucky, all but one of which also occur in Tennessee. Tennessee has one unnamed endemic and another form shared with Alabama and Georgia. The Mobile system and adjacent Gulf drainages have four or five additional species. Ten unnamed species, usually restricted to single basins, is a fair guess based on current information. By basins my estimate is: Kentucky (1), Green (2), Cumberland (4), Tennessee (4), Mobile (5), and Escambia (1). Imprecision in regional studies has already occurred and future confusion will develop unless unnamed forms soon gain formal status. Distinctive coloration, marked in males (color slides shown of 9 spp), is minimal in females. Meristic differences among species are slight.

(251)

Transport of Photosynthates to the Phloem of Cotton Leaves: Kinetics of ^{14}C -Incorporation into the Photosynthetic Products

A. LAUCHLI, *Department of Plant Sciences, Texas A&M University, College Station, Texas 77843*

Data from the literature indicate that the velocity of photosynthate export from leaves in the phloem is lower in cotton than in some of the C_4 plants. I have begun a study to determine the physiological events in cotton leaves which may be rate-limiting for the translocation of photosynthates in the phloem.

Cotton plants (5 to 6 weeks old) were exposed to $^{14}\text{CO}_2$ in a fumigation chamber for periods up to 30 min. From the fourth leaf, the compounds soluble in ethanol were extracted and radioassayed, the leaf exposed to x-ray film to obtain the pattern of ^{14}C -starch distribution, and the radioactive starch detected. The experiments show that ^{14}C was rapidly incorporated into the H_2O -soluble fraction and the starch. Autoradiographs revealed that the mesophyll became loaded with ^{14}C -starch within about 5 min. exposure to $^{14}\text{CO}_2$, whereas the veins remained essentially unlabeled for at least 5 min. The results will be discussed in relation to the transport of photosynthates into the phloem.

(234)

Nutritional and Metabolic Studies of Two Pigment Producing Isolates of *Spirillospora*

RICHARD C. LEONARD
University of Alabama in Huntsville

Spirillospora 1309-b and 1230 (after Couch's isolate numbering system) have produced dark azure blue pigments when grown on stock agar cultures. Nutritional studies were carried out on each of the isolates in liquid media. Agitation was required when grown in liquid culture. Growth occurs with an optimum temperature of ca. 30°C and a maximum temperature of 40°C . *S. 1309-b* produced measureable growth and pigment production when grown in liquid cultures containing single amino acids in combination with half strength Czapek's whereas, no growth or pigment was obtained when grown on other single amino acids. No growth was obtained on any carbohydrates in combination with half strength Czapek's. Metabolic studies using the Gilson respirometer indicated the non-utilization of carbohydrates with amino acid oxidation varying with the age of the mycelia. *S. 1230* produced measureable growth on single carbohydrate sources as well as certain single amino acids. In liquid culture no measureable pigment production was obtained on any sources which produced growth. Metabolic studies indicate that utilization of certain amino acids varied with the age of the mycelia whereas, metabolism of certain carbohydrates remained the same.

(21)

Aspects of the Biology of the Spiny Searobin, *Prionotus alatus* (Pisces: Triglidae), from the Northeastern Gulf of Mexico

THOMAS C. LEWIS, *The Florida State University*

Specimens of *Prionotus alatus* ranging in size from 24 to 146 mm SL were collected from the northeastern Gulf of Mexico from October, 1969 to September, 1971. Depth of capture and temperature ranged from 40 to 190 meters and 11 to 28°C respectively. The species as a whole showed no distinct bottom preference. Examination of gonads representing one year's collections (October, 1970 to September, 1971) revealed that in most of the months ripe females were present indicating that *P. alatus* probably spawns throughout most of the year. Preliminary data seem to indicate that both sexes reach sexual maturity at around 100 mm SL. Stomach content analysis reveals that *P. alatus* in the northeastern Gulf of Mexico feeds almost exclusively on crustaceans.

(216)

Dimethylformamide Toxicity and Pathology in *Meriones unguiculatus*

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Dimethylformamide (DMF) has a history as a potent chemical carcinogen but when small doses such as 0.1 to 0.2 ml are injected into rats there is negligible pathology. This is particularly true with the liver, the target organ. The intraperitoneal (IP) LD_{50} for DMF

in adult male rats has been reported to be 3800 (3100 to 4600) mg/kg. Ironically the use of DMF as a solvent for other carcinogens is almost common place, especially with the insoluble aflatoxins. Such toxins are soluble in water in the 10 to 30 µg/ml range and slightly more soluble in alcohols. For experimental purposes such volumes of water or alcohol as required for administrations is not feasible. With DMF it has been found that aflatoxin B₁ is at least soluble in the 20 mg/ml range.

When preliminary work was begun in the study of aflatoxin responses in the Mongolian Gerbil, *Meriones unguiculatus*, problems developed with the solvent, DMF.

There are indications that this species is highly sensitive to DMF. Subcutaneous injections of 0.1 to 0.2 ml produced lesions in the liver. These included zones of diffuse necrosis, hyperchromatic nuclei, abnormal numbers of mitotic figures, giant nuclei and hematoxylin. In general DMF resulting gerbil pathology was that of toxic hepatitis and congested kidneys. Identical quantities of DMF resulted in 25% level of lethality within three days when injection into 50 gram females. IP injections of 0.16 ml of DMF when given to both sexes resulted in 100% lethality.

DMF in the drinking water, 14:1 (v/v, water/DMF) caused 75% of the animals to die when the average total consumption was 0.3892 ml of DMF. In this concentration and all the above injections, animals had a rapid loss of weight 1 to 5 days prior to death. This loss usually amounted to 7.3% of their body weight. At 28:1 and lesser concentrations there was no marked weight loss, but 59% of the animals receiving 28:1 succumbed after consuming 0.1996 ml of DMF. At 100:1 in the drinking water, 12.5% of the animals died after 6 weeks. Here the mean consumption of DMF as consumed by the dead animals was 2.19 ml.

(210)

Hemoglobin Phenotypes in Populations of the Yellow Bullhead (*Osteichthyes*, *Siluriformes*, *Ictaluridae*, *Ictalurus natalis* (LeSueur)) *

THOMAS E. LODGE, *University of Miami*

Yellow bullheads have been found to have multiple hemoglobins in studies using starch gel and cellulose acetate electrophoresis. The blood of individual bullheads has been determined to contain ten electrophoretically distinct hemoglobins. Specimens collected throughout the state of Florida and specimens collected near Cleveland, Ohio, were consistent in having the same ten hemoglobins. However, these specimens often differed in the ratio of concentrations of the individual hemoglobins. Six distinct phenotypes have been found, each having its own characteristic pattern of concentrations of the ten hemoglobins. Specimens kept in the laboratory for periods up to two years have been shown to retain their original pattern. The frequency of geographical distribution of each of these phenotypes has been studied. It seems highly probable that these hemoglobin phenotypes represent adaptations to regional stresses in the aquatic environment, particularly with regard to oxygen and carbon dioxide tensions and temperature. Molecular weight determinations and subunit studies are currently being completed on the individual hemoglobins.

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(122)

Twilight Movement Patterns of Some Florida Snakes and Potential Predators

MICHAEL S. LOOP, *Florida State University*

During the summer months of July and August a series of roads in the Tallahassee, Florida area were driven during the four hour period around sunset. All species of snakes and potential predators seen crossing the road were recorded along with the time of encounter to the nearest minute from sunset that day. The temporal distribution patterns were clearly species idiosyncratic for both the snakes and their potential predators. Furthermore preliminary indications of a suppression of snake activity during the week of the full moon was found.

(121)

The Effect of Relative Prey Size on the Ingestion Behavior of Rodent Eating Snakes: *Boidae*, *Colubridae*, and *Viperidae*

MICHAEL S. LOOP AND LAWRENCE G. BAILEY
Florida State University

Snakes (N = 18) representing six different species, *Python molurus*, *Constrictor constrictor*, *Elaphe obsoleta*, *Lampropeltis getulus californiae*, *Drymarchon corais*, and *Crotalus adamanteus*, of diverse evolutionary position and prey capture techniques were fed live mice of a variety of sizes. A quantification of relative meal size, ingestion ratio, was employed to evaluate the effect of mouse size on the probability of the snakes (1) employing their species specific prey capture technique and (2) ingesting the prey head first. Results indicated that the probability of the prey capture technique being employed and head-first ingestion were both a monotonic function of the relative size of the mouse to the snake. Furthermore the constrictors and venomous species located large prey's head prior to any attempted ingestion indicating recognition of the head.

(9)

A Simple Apparatus for Delivering A Heat Shock to Microscopic Aquatic Organisms

GENE LORTON, *Hampden-Sydney College*

An apparatus consisting of a test cell constructed of acrylic plastic with a small resistance heater controlled by a variable transformer was developed to deliver a heat shock to small aquatic organisms while they were being observed through a microscope. Microthermocouples were used to measure the temperature of the fluid in the cell. Response to rapid increase in temperature was determined for the protozoans *Euglena gracilis*, *Spirostomum ambiguum*, *Colpidium colpoda*, *Stentor coeruleus*, *Tetrahymena pyriformis*, and *Paramecium multimicronucleatum*. Response to several constant temperatures was determined for *E. gracilis*, *S. ambiguum*, and *C. colpoda*. Although only protozoans were tested, the apparatus is probably suitable for use with a variety of small aquatic organisms. The principal advantages of this apparatus are the small quantity of test fluid required and the provision for observing microscopic organisms under thermal stress.

(Carried out on a grant from the U.S. Department of Interior, Office of Water Resources Research, Water

Resources Research Center Project B-017-Va. This work was done at the Center for Environmental Studies, Virginia Polytechnic Institute & State University, Blacksburg, Virginia 24061.)

(110)

Postnatal Development, Growth, and Behavior of a Primitive Rodent, *Aplodontia Rufa*

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New data are presented on the growth, development, and behavior of the young of the Pacific mountain beaver, *Aplodontia rufa pacifica* Merriam. Litters of two and four young were born in captivity in the spring of 1966 to two pregnant females wild-trapped in western Oregon. Young were born naked and with eyes and auricular openings tightly sealed. They were unable to crawl and could right themselves only with difficulty, when placed on their backs. At 2 days, the mean weight of the litter of two was 19.8 g, the average body length was 66 mm. Hair covered the body at 2 weeks and lower incisors erupted on the 27th day. Upper incisors emerged 5 days later. Opening of the eyes occurred from 45-53 days. The growth curve of the young was characterized by a rapid increase during the first 8 weeks. Mean body weight at 60 days was 364 g or 43% of adult mean weight (adult mean weight = 806 g). Growth rate was most rapid at 6-8 weeks, coincident with weaning. Certain events in early development of *Aplodontia* can be compared with some sciurids.

Growth data beyond the age of 9 weeks was obtained from young live-trapped during a 2-year field study. The growth of young reached a plateau in 4 months which was maintained throughout their first year at 69% of adult weight. Attempts to mate captive animals were unsuccessful.

(294)

Comparative Studies of the Nodal and Vascular Anatomy in the Cyatheaceae

T. W. LUCANSKY, *University of Florida*

Comparative studies of the vascular anatomy in the neotropical Cyatheaceae are discussed as they relate to the taxonomy and phylogeny of the group. The stelar pattern is basically a dictyostele, although a siphonostele is present in the primitive genera. The presence or absence of a sclerenchymatous sheath and adventitious buds are discussed. There is in the Cyatheaceae (excluding *Metaxya* and *Lophosoria*) a basic nodal pattern which can be explained as based upon four major phases of leaf-trace separations. The petiole pattern also appears to be characteristic for members of the Cyatheaceae with two arcs of petiole strands found in the advanced genera. Fusiform leaf gaps are typical for the family. Nodal and vascular anatomical data basically support the classification and phylogeny of the group. The *Sphaeropteris-Alsophila-Nephelea* line shows certain tendencies toward increasing complexity of the nodal anatomy, whereas the *Trichipteris-Cyathea-Cnemidaria* line shows the same anatomical characters in a direction of increasing simplification.

(102)

Seasonal Variations of Soil Fungi Demonstrated by the Strip Bait Method

HAROLD F. MABEE, *East Tennessee State University*

A study was made to determine composition of the fungal community from the soil surrounding a *Liriodendron tulipifera* L. (Tulip Tree) in the Cherokee National Forest, Tennessee. Luttrell's Strip Bait Method, employed during this study, resulted in 243 isolates which represented 24 genera. Strip baits were placed out two weeks during four seasonal periods. The results for each period were compared and a seasonal variation between several genera was noted. Those genera which demonstrated the greatest seasonal variation were *Penicillium*, *Trichoderma*, *Sepedonium*, *Mucor* and *Verticillium*. Previous studies of soil fungi utilizing soil dilution plate methods noted an absence of seasonal variation. This is because the dilution plate method in addition to isolating active mycelia, isolates dormant fungal forms which are waiting for more favorable conditions to flourish. In contrast, the strip bait method utilizes present soil environment and becomes more sensitive to the seasonal variation of soil fungi.

(93)

NAD and NADPH Oxidase Systems in *Euglena gracilis* var. *bacillaris*

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AND JOSEPH B. MYERS
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Several oxidase systems have been found in cell free extracts of an Illinois Institute of Technology streptomycin-bleached strain of *Euglena gracilis* var. *bacillaris*. The systems identified were NADH and NADPH-linked diaphorases; NAD and NADP-linked cytochrome reductases; NAD and NADPH-linked oxidases and NAD-linked lipoid dehydrogenase. NAD transhydrogenase was not demonstrable in the cell free extracts. Effects of pH, substrate concentration, enzyme concentration and lability of the above mentioned enzymes were studied. Electrophoretically, NADH and NADPH diaphorases were shown to be molecularly heterogeneous. Partial purification of the above enzymes and the effects of metabolic inhibitors have been studied.

(Supported by a grant from the Research Corporation, Research Publication No. 35 of the Atlanta University Center Science Research Institute.)

(137)

Effects of Total Body X-Irradiation and Route of Inoculation on Susceptibility and Hematologic Response of Mongolian Jirds (*Meriones unguiculatus*) to *Brugia pahangi*

J. B. MALONE, J. W. MCCALL, W. L. CHAPMAN, JR.,
H. S. AH, P. E. THOMPSON
University of Georgia

Total body x-irradiation of male jirds was followed in 1-5 hours by injection with 43 infective larvae of *Brugia pahangi*. The percentage (31% vs. 14%) of adult worms recovered at 120 days from jirds receiving x-irradiation was significantly higher than that from non-irradiated jirds. There was no significant difference in numbers of worms recovered from jirds receiving a single exposure of 700R as compared to jirds receiving

additional exposures of 300R on days 31 and 56 post-infection. Intraperitoneal injection of infective larvae into non-irradiated jirds resulted in significantly higher (37% vs. 14%) worm recoveries than did subcutaneous injection of larvae. Following intraperitoneal injection of infective larvae, 84% of the worms recovered were from the peritoneal cavity. Female worms averaged approximately 1 cm. longer than female worms found in lymphatics. Following subcutaneous injection, larvae localized in the lymphatics or in the heart and lungs. Irradiation had no apparent effect on worm localization or size. Hematologic data indicated a marked eosinophilia assorted with moulting. As a source of worms for filariasis studies, intraperitoneal injection with infective larvae promises to be a valuable procedure for improving certain aspects of the *B. pahangi*-jird model system. Results suggest that immunosuppression by x-irradiation increases numbers of worms recovered.

(269)

Comparative Reproductive Ecology of an Oviparous and a Viviparous Species of the Genus *Sceloporus*

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The reproductive cycles of the lizards *Sceloporus undulatus*, an oviparous form found in open forest regions of the southern United States, and *Sceloporus malachiticus*, a viviparous species from the cool, wet highlands of Central America, are examples of two different approaches to reproductive effort within the same genus. The smaller, oviparous *S. undulatus* is early-maturing and multiple-brooded, whereas the larger, viviparous *S. malachiticus* is late-maturing and singly-brooded. Furthermore, *S. malachiticus* has fewer young, but they are larger, resulting in a greater reproductive effort per clutch.

The differences in reproductive strategy reflect an adaptation to climatic differences, with viviparity in *S. malachiticus* apparently being an evolutionary response to its more restrictive thermal environment. The hypothesis is supported by failure of *S. undulatus* eggs to hatch at incubation temperatures similar to the mean ambient temperature of *S. malachiticus* habitat.

(319)

Confirmation of Homologous Genomes in Some African and New World Species of *Hibiscus* sect. *Furcaria* (Angiospermae: Malvales: Malvaceae)

DIANA W. MARTIN AND MARGARET Y. MENZEL
Florida State University

Five New World allotetraploids, including *Hibiscus furcellatus* Lam. and *H. peruvianus* R. E. Fries, all have similar genome constitutions. *H. rostellatus* Guill. et Perr., an African tetraploid of genome constitution GGHH, shares one genome with members of the American alliance. The rare African diploid *H. sudanensis* Hochr. is a G genome tester. Cytological analysis of hybrids combining the experimental allotetraploid *H. surattensis-sudanensis* F₂ (BBGG) with *H. furcellatus* suggests that this shared genome is G. (Chromosomes of the New World tetraploids do not pair with the B genome). Chromosome pairing in recently obtained direct hybrids between *H. peruvianus* and *H. sudanensis* confirms that the American tetraploids have

a G genome. The genome formula for *H. furcellatus*, *H. peruvianus* and their allies is thus designated GGPP. It is suggested that primary dissemination of the G genome occurred on the ancient supercontinent of Gondwanaland.

(240)

Slime Layers in Blue-Green Algae

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East Tennessee State University

Many strains of blue-green algae form diffuse slime layers that generally go unnoticed except when mounted in India ink. We have examined this property in several axenic coccoid and filamentous species. In only a few forms (usually *Nostoc*) is differentiation between slime and sheath layers particularly difficult. Slime may occur (regularly or irregularly) in species without readily detectable sheaths and also in forms with heavily structured ones. Slime production seems to be consistent within species although the extent of the actual investment can be varied by cultural conditions. All of our slime-producing strains examined to date appear to be aquatic. In gently-shaken cultures, small macroscopic clumps are more common to slime-producers whereas formation of entangled mats is characteristic of strictly "sheathed" forms. Slime production and motility on agar plates appear inversely related; colonies do not spread but rise like miniature haystacks on the agar surface. Slime may not insulate against adversity because, contrary to what might otherwise be expected, euplanktonic slime producers almost never survive transplant to agar plates, whereas some non-slime-producing euplanktonic strains grow well on solid medium.

(24)

Notes on the Parasites of Choctawhatchee Bay Catfishes

RALPH MARTIN, *University of West Florida*

Presented by title. Abstract not available.

(316)

Forest Communities of the Great Valley of East Tennessee

WILLIAM H. MARTIN, *Eastern Kentucky University*

The complex geology, diverse topographic features, and numerous soils associated with the Ridge and Valley physiographic provinces in Tennessee provide equally diverse habitats for plant establishment and survival. Fifty-two tree taxa, the dominants in the stable plant communities, suggest a floristically diverse area in comparison with other studies in deciduous forests. Oaks and hickories comprise over 30% of the total taxa. Forest communities of low-lying ridges and on rolling to flattened topography of the uplands are a complex dominated by *Quercus alba*; co-dominants vary depending upon soil and site characteristics. This community complex is greatest in areal extent. *Quercus alba* is the major tree taxon in this region and has the greatest ecological amplitude.

A complex dominated by *Quercus prinus* is associated with the xeric habitats of the prominent sandstone ridges. Communities recognized as relic mixed mesophytic communities and those dominated by *Lirioden-*

dron tulipifera are associated with greater relief, topographic diversity and/or topographic protection. Communities occupying habitats limited in areal extent may be dominated by taxa, e.g., *Quercus muhlenbergii*, *Q. phellos*, *Q. rubra*, that apparently have restricted limits of tolerance. *Castanea dentata* was a major constituent in many communities; replacing taxa appear to be *Quercus alba* and/or *Q. prinus* and *Carya glabra*.

(272)

Alternative Patterns of Ancestrula Development in the Bryozoan *Styloponia informata* (Lonsdale) [Gymnolaemata, Cheilostomata, Schizoporellidae]

FRANK J. S. MATURO, JR. AND MARY ANN MIDDLETON
University of Florida

In *Styloponia informata* (Lonsdale) there are two patterns of development ("triplet" and "multiple" zooid) leading to the formation of 9 ancestrular zooids, rather than to the usual 1 to 3 ancestrular zooids of other bryozoans. The postsettlement larva forms a flat disc which becomes divided into three equal sectors by the development of 3 walls radiating out from the center. Each sector then becomes subdivided into thirds by the appearance of 2 parallel walls, which run from near the mid point of the original walls to the nearest points on the margin which will divide the latter into 3 equal arcs. In the triplet zooid pattern, the central compartment of each sector rapidly develops into a functional zooid; the remaining compartments differentiate later. In the multiple zooid pattern, all compartments develop at essentially the same rate. Both patterns appear to occur with equal frequency under identical culture environments.

(287)

Monogenetic Trematodes of Some North Carolina Centrarchids

MONTE A. MAYES AND GROVER C. MILLER
North Carolina State University

Three hundred and seventy-five fishes of the family Centrarchidae were examined for monogenean parasites between March, 1970 and July 1971. Forty-two species of parasites were recovered, including a new genus and six new species. *Clavunculus okeechobensis* n. comb. was redescribed. A high degree of host specificity was observed as only 10 species of monogenetic trematodes infested two or more host species. Consequently, phylogenetic implications were made concerning hosts harboring the same trematode species.

(75)

An Ecological Analysis of Energy Demands and Resources

J. FRANK MCCORMICK, University of North Carolina

Population increase and the even greater rate of growth in per capita energy consumption have placed demands upon energy resources which can only partially and temporarily be provided by conventional fossil fuel plants. Although there are several alternatives to fossil fuels as sources of electrical power, the most feasible alternative on a regional, national, or world basis is nuclear power. Fortunately, nuclear power plants are cleaner and safer than fossil fuel plants and thereby pose fewer threats to environmental quality and to

public health. Unfortunately, poor engineering, ignorance, and lack of concern for the environment have, in many cases, resulted in degradation of environmental quality due largely to thermal effluent or radionuclide emissions. These ecological misfortunes should be designated as correctable errors in judgment rather than as attributes inherent to nuclear power plants. The most direct means of correcting these problems is for public opinion to be more strongly influenced by results of research conducted by professional ecologists and environmental scientists rather than the unwarranted fears of the misinformed or uninformed.

(138)

Comparison of *Brugia pahangi* Infections in Mongolian Jirds (*Meriones unguiculatus*) Following Intraperitoneal and Subcutaneous Injections

J. W. MCCALL, H.-S. AH, J. B. MALONE, AND
P. E. THOMPSON, University of Georgia

Recent work (Ash and Riley, *J. Parasitology*, 56: 962, 1970) has shown that Mongolian jirds can be infected by the subcutaneous route with *Brugia pahangi* and that most of the worms develop in the lymphatics. (Ah, unpublished) and a few in the heart and lungs. In such infections, the procurement of large numbers of developing larvae or adult worms is tedious. Inoculation by the intraperitoneal route is being investigated as a possible means of inducing infections that are more amenable to various uses than those induced by subcutaneous injection.

(267)

Osteology of the Skull and Atlas of *Amphiuma pholeter* Neill (Amphibia: Urodela: Amphiumidae)

D. BRUCE MEANS, Tall Timbers Research Station

The atlas, and bones of the skull and mandible of *Amphiuma pholeter* Neill are described for the first time and compared to *Amphiuma means* Garden. An atlas-mandibular ligament is present in *A. pholeter* and is similar to that in plethodontid salamanders of the subfamily Desmognathinae; the palate is more like that in Salamandridae. The atlas of *A. pholeter* compares closely with that of the Cretaceous salamander, *Proamphiuma cretacea* Estes. *A. pholeter* is considered to be a valid species based on its distinctive morphology.

(266)

Notes on the Autumn Breeding Biology of *Ambystoma cingulatum* (Cope) (Amphibia: Urodela: Ambystomatidae)

D. BRUCE MEANS, Tall Timbers Research Station

Ambystoma cingulatum (Cope) is the second salamander of the subgenus *Linguelapsis* reported to be an autumn breeder. Breeding migrations were observed in western Florida in October 1970, 1971. Single eggs (3 capsules) were laid attached to bottom litter of outdoor aquaria in mid-November. Aquarium hatchlings emerged the first week of December; they were not significantly different from older larvae in color pattern. Larvae underwent transformation in late April

in the field, but were induced to transform in the lab as early as late March. Individuals raised from larvae attained adult size by the following October.

(288)

A Maintenance Diet for *Australorbis glabratus* (Gastropoda, Pulmonata, Planorbidae), the Intermediate Host of Schistosomiasis Mansoni

JOHN A. MECHAM AND R. B. HOLLIMAN
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Two groups of *Australorbis glabratus* snails were infected with *Schistosoma mansoni* miracidia. One group was then maintained on boiled lettuce while the other group was maintained on Purina® Rat Chow®. No differences were noted in the number of infected snails surviving or per cent infected. However, the average size of the infected snails maintained on lettuce was 11 mm as compared to 20 mm for those maintained on Rat Chow®, and no progeny 4 mm or larger were in the lettuce maintained tank as compared to 413 offspring 4 mm or larger in the Rat Chow® maintained tank. Measurements and counts were made 7 weeks after infection. It is recommended that a good maintenance diet, where excellent snail reproduction rate is required, consist of boiled lettuce supplemented with small amounts of Purina® Rat Chow® at the rate of approximately 3 grams of Chow® per week per 50 snails.

(315)

The Potentials of Weeds

WILLEM MEIJER, *University of Kentucky*

The time has come that botanists speak up more forcefully about the virtues of weeds, plants growing in disturbed habitats. They are not all that bad for a good management of agriculture and sound forestry, and many of them give color variation to lawns and are interesting objects for biological and ethnological studies. Evidence is being collected that many plants which agriculturists and foresters try to destroy have good potentials for food, medicines, soil cover, as vectors in biological insect control or as ornamentals. One man's weed is another man's crop plant. The evolution of several crop plants had not been possible in case they would not have grown together with weeds. Research is centering around the production and spread of weeds in the Eastern USA, the resistance against invasion by weeds of various natural ecosystems, the origin and spread of local weeds since the last glaciation, the biosystematics of some weed genera in relation to the ecology of their species, the new interest in weeds through the movement of organic gardening and the production of health foods, and the biological control of weeds in tropical forests. The use of herbicides in the USA on more than 120 million acres at a cost of more than 500 million dollars and the destruction of 5 million acres of forests in Vietnam by herbidal sprays can be blamed for a great part on the lack of fundamental ecological and general biological weed research in this country.

(159)

Sucrose Solution Solute Potentials

BURLYN E. MICHEL, *University of Georgia*

Solute potentials of sucrose solutions calculated from published osmotic coefficients derived from isopiestic vapor pressure methods differ by 2.8 to 8.0 percent from those obtained by converting published osmotic pressures derived from hydrostatic pressure osmometry. Freezing point depression and vapor pressure osmometer data support the isopiastically determined values. The discontinuity between 25 and 30°C found in data from hydrostatic pressure osmometry does not appear in data from vapor pressure osmometry. Temperature effects should be investigated additionally.

(241)

Cytological Development of *Iodophanus granulipolaris* (Pezizaceae, Ascomycetes)

JAMES R. MILAM AND J. W. KIMBROUGH
Botany Department, University of Florida

A cytological developmental study of *Iodophanus granulipolaris* has been made by the use of light microscopy. Ascus formation is preceded by development of various sterile elements, ascogonia, ascogenous hyphae, and croziers. Sexual reproduction is dependent upon the presence of light. Many aspects of apothecial development, especially meiosis and ascosporeogenesis display a diurnal response. Following karyogamy in the penultimate cell and growth of the ascus mother cell, the resultant nuclei undergo two meiotic divisions and a postmeiotic mitosis. The presence of centrosomal plaques, which are always found contiguous to the nuclear membrane, and the intranuclear location of the spindle apparatus were observed. After mitosis eight elliptical, uninucleate ascospores are delimited in each ascus. The outer wall of the ascospores are marked with tack-shaped, cyanophilous ornaments which are concentrated at the poles and to a lesser extent on the lateral portions. Vegetative hyphae, medullary and ectal excipular cells, paraphyses, and excipular hairs are multinucleate and septate.

(155)

The Influence of Soil Moisture on Short-Interval Leaf Movements

CHARLES S. MILLER, *Department of Plant Sciences, Texas A&M University*

Gossypium hirsutum L. var. Lankart plants were greenhouse-grown for 20-40 days in two different potting mixtures prior to placement of the plants under continuous light for two weeks of time lapse photographic observation. The temperature, light and relative humidity were maintained constant. Moisture stresses were induced by withholding water. The plants were placed on a scale to enable moisture content determinations of the potting mixtures and a clock was included for time reference.

Different types of short interval rhythms were observed within fairly definite moisture stress levels. The SIRV (short interval rhythmical vertical) movements occurred at the higher moisture levels. The SIHM (short interval horizontal movements) occurred at the next lower moisture levels. These were followed by the SHAKE (short-stroke SIRV) movements at

lower levels. Continued stresses induced cessation of the SLEEP (diurnal, circadian) movements at which point wilting occurred.

The moisture stresses did not act as the triggering mechanism but served as limitations or boundaries beyond which the different types of movements would not occur if activated.

(167)

Response of Young Loblolly Pine to Foliar Applications of Urea

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A study was made of the growth response and tolerance of loblolly pine (*Pinus taeda*) to highly concentrated foliar sprays of urea. The treatments ranged from 10 to 100 grams of urea-N per tree in 500 ml of water, and were applied in late March to individual trees in a 5-year-old plantation in east central Alabama.

Little damage was observed in the March application, but similar treatment in July severely burned the foliage. All mortality in the March application involved the smallest trees within the highest treatment rate, and was 7 per cent of that treatment. An increase in basal area and in dry weight, length, and total N content of needles in the last completed flush was observed at the end of the growing season. Fascicle dry weight or mg N/fascicle was found to be much more closely related to treatment and basal area growth than foliar per cent N.

* Senior author currently at Duke University.

(180)

NADH Diaphorase in *Euglena gracilis*, strain Z

ROBERT A. MOORE, FRISSELL R. HUNTER, AND
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NADH diaphorase (oxidase) has been spectrophotometrically demonstrated in *Euglena gracilis*, strain Z with dichlorophenolindophenol as the electron acceptor. The effects of enzyme concentration, storage at -5 degrees Centigrade, and substrate concentration upon the activity of the enzyme have been studied. Utilizing polyacrylamide gel disc electrophoresis with nitroblue-tetrazolium as the final electron acceptor, the enzyme system shows molecular heterogeneity. The data already obtained plus the data of the experiments in progress will be discussed.

(209)

Response of Fish in a Pollution Monitoring System to a Diurnal Temperature Cycle

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Virginia Polytechnic Institute and State University

A continuously operative pollution monitoring system employing photocell devices measured individual swimming activities of six bluegill (*Lepomis macrochirus* Raf.) for eight days in the laboratory. Fish were subjected to a diurnal temperature cycle reported in June 1961, for a control station free of thermal effluents in the Potomac River. Abnormal activity was distinguished from normal activity by changes in variance of

light beam interruptions recorded. No abnormal activity patterns were detected as a result of temperature changes. These results indicate that temperature fluctuations of this type will not produce false responses from the pollution monitoring system. Details of the operation of this monitoring system may be found in W. T. Waller and John Cairns, Jr. (in press) Water Research. This work was supported by funds provided by the Department of the Interior, Office of Water Resources Research, administered by the Water Resource Research Center as project A-039-VA, and by the Manufacturing Chemists Association.

(166)

Auxin-Transport Inhibitors as Promoting Agents for Leaf Abscission

PAGE W. MORGAN AND JAMES I. DURHAM
Texas A&M University

Reduction in petiolar auxin transport has been proposed to be one of the functional actions of endogenous or exogenous ethylene as it regulates intact leaf abscission (Plant Physiol. 48:208-212, 1971). If this hypothesis is correct, auxin-transport inhibitors should hasten the rate or amount of abscission achieved with a given level of ethylene. As thus predicted we found that three auxin transport inhibitors promoted ethylene-induced, intact leaf abscission when applied to the entire cotton plant (*Gossypium hirsutum* L., cv. Stoneville 213) or specific petioles. In addition, the transport inhibitors caused rapid abscission of leaves which usually do not abscise under the conditions employed, and they did not induce abscission within one week unless coupled with exogenous ethylene or that derived from 2-chloroethylphosphonic acid (Ethrel). The results reveal that reducing the auxin supply to the abscission zone materially increases sensitivity to ethylene, a condition which favors a role of endogenous ethylene in abscission regulation. Such a role of ethylene points up the importance of auxin-ethylene interactions in the overall hormone balance of plants and specific tissues.

(321)

Disk Flower Variation in *Coreopsis* and the Taxonomic Implications

ANNA M. MUELLER, *University of North Carolina*

Disk flowers have been examined in the genus *Coreopsis* and it was found that species in sections *Eublepharis* and *Calliopsis* have four merous disk flowers as compared to five merous disk flowers in other sections. Additional characters were examined and it was found that the following characters unite this group of species: disk flowers four merous, small, and numerous; style branches truncate or terminated with a very obtuse cone; small outer involucreal bracts; paleae deciduous with the fruit; achenes straight or very slightly curved; and receptacle conic when achenes have been shed. Previously unreported chromosome counts have been obtained for seven species. Two chromosome series exist, one of 12 and the other of 13. The taxonomic implications of this will be discussed.

(170)

Aspects of Thymidine Metabolism in Germinating Peanut Axes

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Evidence was obtained for the existence of thymidine kinase (TK) and thymidylate phosphatase (TMPase) as separate enzymes in axes of germinating peanut seed (*Arachnis nypogaea*). The enzymes differed in heat stability and in optimal assay temperature. TK and TMPase exhibited different buoyant densities as determined by density gradient centrifugation but could not be separated by ammonium sulfate fractionation or by gel filtration on Sephadex G-100. TMPase activity appeared in the axes between 36 and 48 hours after imbibition while TK activity was initiated between 48 and 60 hours. Incubation of germinating axes in either cycloheximide (100 µg/ml) or dactinomycin (50 µg/ml) caused a decrease in extractable enzyme activity of both enzymes.

(290)

The Trichome Complement of the Genus *Aureolaria* Raf. (Scrophulariaceae)

LYTTON J. MUSSELMAN, University of North Carolina

All North American species of *Aureolaria* possess similar glandular trichomes on the youngest leaf primordia. The trichomes consist of a two celled head with densely staining cytoplasm resting on a single chlorophyllous base cell which in turn is borne on a stalk composed of a single row of three to five cells. From this basic trichome type various developmental patterns and trichome complements arise. The mature leaves and stems of *Aureolaria virginica* (L.) Pennell and *A. grandiflora* (Benth.) Pennell have only a single trichome type, a simple hair which arises by shedding of the head cells and base cell followed by elongation of the stalk cells. *Aureolaria laevigata* (Raf.) Raf. and *A. flava* (L.) Farw. are glabrous at maturity as a result of the loss of glandular trichomes at an early age. *Aureolaria pedicularia* (L.) Raf., sensu lato, has glandular hairs, simple hairs, and stellate hairs. The glandular hairs of this species develop by periclinal divisions of the head cells followed by anticlinal divisions of the stalk cells. Simple hairs develop as in *A. virginica* and are the only trichome present on the rosette of this biennial. The taxonomic value of trichome characters in the *A. pedicularia* species complex is viewed in relation to the possible role of environment in trichome development. Similar trichomes and trichome developmental patterns are shown for the related genera *Agalinis*, *Castilleja*, *Macranthera*, *Pedicularis*, *Seymeria*, and *Tomanthera*. These are considered in the light of previous work on the supposed basic trichome type of the Rhinanthoideae.

(95)

Fine Structure of an Insect Myocardium

JOSEPH B. MYERS, Atlanta University

Electron microscopic study of the myocardium in *Blaberis giganteus* (Orthoptera: Blaberidae) revealed that the myocardium or dorsal vessel is subdivided into three layers, tunica externa, tunica media, and tunica

interna. The tunica media comprised the musculature of the dorsal vessel whereas the outer and inner layers were similar in cellular composition. Myofibrils of the posterior muscle cells were different from those of the anterior muscle cells. The difference appears to be in the organization of the sarcomeres. The posterior two-thirds of the dorsal vessel contained sharply defined myofibrils which were parallel to the long axis of the cell whereas in the anterior portion the myofibrils lie in a disorganized pattern. The pericardial septum consisted of an outer and inner filamentous layer that covered an array of elongated cells. Fenestrations were distributed along the septum. Observations of other closely associated structures such as the tracheal system, nerves and hemolymph matrix are also included in this study.

(This work was supported by a Ford Foundation Fellowship.)

(78)

Effects of Mirex Insecticide on Selected Fresh-Water Invertebrates

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Bioassays in technical mirex were conducted for 24 to 144 hrs on *Dineutes americanus* (Coleoptera: Insecta), *Gerris remigis* (Hemiptera: Insecta), *Macromia* spp. (Odonata: Insecta) and *Palaemonetes kadiakensis* (Decapoda: Crustacea). Probit analysis was performed on an IBM digital computer to determine the LD₅₀ values in ppm. These values are: for *D. americanus*—2.061 (24 hr), 0.104 (48 hr), .039 (72 hr); and for *G. remigis*—0.130 (24 hr). Delayed mortality effect of mirex was exhibited by other tests. In 1 ppm mirex treated *P. kadiakensis*, 30% (24 hr) to 100% (96 hr) mortality occurred; and 32% (24 hr) to 96% (144 hr) mortality ensued in *Macromia* spp.

The effect of mirex on the respiratory rate was also determined. Test animals were pretreated in 1 ppm mirex for 24 hrs; incubated for 5 hrs in B.O.D. bottles and change in oxygen (O₂ consumption ppm/hr/gm) recorded by an oxygen electrode meter. Compared with the controls the increase in respiration was 2.3 fold in *Macromia* spp. and 2.6 fold in crayfish, *Orconectes lancifer*. Slight increase in respiratory rate was also noticed in *Glossiphonia* spp., *P. kadiakensis* and *Chironomus* spp. (Diptera: Insecta).

(264)

Amphibian Activity Along the Periphery of a Heated Reservoir

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AND
Michigan State University

Seasonal movement and activity of amphibians were monitored for one year via pitfalls and drift fences. Traps sampled a 2200 m periphery of a reservoir receiving thermal effluent from a nuclear reactor in South Carolina. Captures at various trap sites reflect habitat preferences of most species. Seasonal patterns of amphibian activity are comparable with other study areas on the Savannah River Plant. Occurrence frequencies of herptile groups are presented.

(158)

Dual Pattern of DL-Leucine-1-¹⁴C Absorption by Root Tips of *Lemna Minor* L.

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The concepts of enzyme kinetics have been applied to the absorption of DL-Leucine-1-¹⁴C by root tips of intact duckweed plants. The rate of absorption as a function of the external leucine concentration between 0.01 mM to 0.02 mM shows saturation kinetics according to the Michaelis-Menten relation. This lower concentration mechanism reaches a maximal rate at 0.2 mM. The Michaelis constant is about 0.03 mM. When the external concentration is increased to 5 mM, the rate of absorption rises to values far greater than those calculated on the basis of the relation applying for the range of low concentrations. Consequently, the absorption of DL-Leucine by duckweed roots follows a dual pattern as has been found for the absorption of many other solutes by plants.

(37)

The Effect of Centrifugation of Oat Seeds on Seedling Development

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Centrifugation of dry oat seeds has no effect on subsequent seedling growth; however, when the seeds are centrifuged submerged in water inhibition results. Within limits inhibition of seedling growth increases (1) with increase in the length of soaking time in water prior to centrifugation, (2) with increased duration of centrifugation, (3) with increase in relative centrifugal forces up to 20,000 × g.

The application of direct hydrostatic pressure to oat seeds in a pressure chamber reveals strikingly similar inhibition of seedling development.

Apparently the effect of centrifugation on *Avena* seeds is directly related to water content of the seed and to the hydrostatic pressure produced by centrifugal force on the water column covering the seeds.

(273)

Further Observations in Georgia on the Land Planarians, *Bipalium kewense* and *Geoplana vaga* (Turbellaria: Tricladida: Terricola)

DONALD A. OLEWINE, Georgia Southern College

Bipalium kewense is a natural predator of earthworms. A series of pictures have been taken showing the entire feeding response of *Bipalium kewense* from capture of the earthworm through digestion and absorption. Within 45 minutes an earthworm larger than the planarian was captured and totally ingested. The control of a *Bipalium kewense* infestation of a large earthworm farm has been observed. Various controls were attempted. The most effective procedure was to flood the beds daily with water driving the planaria to the surface where they were removed by hand. This practice enabled earthworm production to return to normal during the summer of 1971. Seven specimens tentatively identified by gross morphological characteristics as *Geoplana vaga* have been collected in Statesboro, Bulloch County, Georgia. This is

believed to be the first time that this genus has been reported on the east coast. Previous published reports limited this genus to the west coast. At the time of collection several *Geoplana* have been observed actively feeding on a crustacean, *Armadillium vulgare*, the common pill bug.

(70)

Limnological Studies of a Southeastern Stream

L. M. OUTTEN, Mars Hill College

Sixty-three field studies concerning the biotic, physical, and chemical conditions relating to the water quality of Gabriel Creek, a tributary of Ivy Creek and the French Broad River, Tennessee River System, near Mars Hill, Madison County, North Carolina, were made during the period from September 16 through December 20, 1971. Characteristics of Gabriel Creek and its tributaries considered in the study included dissolved oxygen, carbon dioxide, chlorine, nitrogen, phosphate, pH, alkalinity, hardness, temperature, color, odor, turbidity, settleable and suspended solids, sludge, indicator organisms, current, flow, bottom, banks, depth, width, and gradient.

(64)

Culture of Pea Seedling Explants and the Problem of Apical Dominance

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University of North Carolina, Chapel Hill

Single nodes isolated from 11 day-old *Pisum sativum* L. cv. Alaska seedlings have been used to investigate some of the factors involved in the correlative phenomenon, apical dominance. Plants were grown hydroponically in a growth chamber under a day-neutral photoperiod at 25°C, until the fifth node was fully exposed. Sections, 3 cm in length, including only the fifth (youngest) node, with adjacent internodes and petiole, were excised and surface sterilized. The sections were then trimmed to 2 cm and placed upright in 3 in deep petri dishes containing an agar-2% sucrose culture medium. The explants were transferred to fresh media every 5 days. The axillary buds of node five began to grow after 2-3 days, and continued to grow during the 2-3 week culture period, when exposed to incandescent and fluorescent light for 12 hr daily. There was no apparent growth, however, of the buds of explants which were maintained in total darkness for the same period of time. This light-dark difference in bud growth as well as the effects of application of various hormones to the explants will be discussed.

(49)

Organic Acid Changes in the Epidermis of *Vicia Faba* As Related to Stomatal Opening¹

J. E. PALLAS, JR.²

Considerable evidence has been published that indicates the increase in guard cell turgor resulting in stomatal opening is brought about by an active transport mechanism driving K⁺ uptake into guard cells. Efforts to identify quantitatively accompanying inorganic anions have not proved fruitful. A plausible explanation for lack of stoichiometry would be that anions of organic acids are produced within guard cells and act as counterions, whereas, the H⁺ produced are exchanged for K⁺.

This hypothesis was tested by using different levels of ambient CO₂ in light to control transpiration, and thus stomatal aperture, and at the same time measuring changes in organic acid production in the epidermis of *Vicia faba*. Epidermal strips were used, quickly frozen in liquid nitrogen, and later extracted.

A positive correlation was found between R_s (indirect measure of stomatal aperture) and CO₂ level. With a two fold decrease in R_s total titratable acidity doubled. Also, organic acid production in the epidermis, as measured by gas chromatography of TMS derivatives, showed a two fold increase. These analysis thus provide the first evidence for associating organic acid production with stomatal opening.

¹ Contribution from the Southern Branch, Soil and Water Conservation Research Division, Agricultural Research Service, USDA; and the University of Georgia Agricultural Experiment Stations. Proposed for presentation at Southern Section of the American Society of Plant Physiology, Mobile, Ala.

² Plant Physiologist, USDA, Watkinsville, Georgia 30677.

(326)

Preliminary Biosystematic Studies in the Virgata Species Complex of *Panicum* (Monocotyledoneae: Poales: Gramineae)

PATRICIA G. PALMER, *North Carolina State University*

Two species of this complex, *Panicum amarum* Elliott and *Panicum amarulum* Hitchcock and Chase, are coastal dune grasses that occur along the Atlantic Coast from Long Island to Florida and along the Gulf Coast from Florida to Texas. Traditionally, these taxa have been recognized on the basis of quantitative morphological characters alone. A preliminary re-evaluation of these taxa utilizing cytological data and chromatographic analysis of flavonoids, as well as morphological and ecological data, suggests that *Panicum amarum* and *Panicum amarulum* are conspecific. However, more extensive studies are needed to confirm this. (Research supported by the National Science Foundation Science Faculty Grant No. 61158.)

(251)

Control of Ribosome Production During Meiosis in Lily Microsporocytes

L. GERALD PARCHMAN, *University of Delaware*

Autoradiographs show that nucleolar RNA synthesis is greatly reduced after synapsis begins during the long (10-day) meiotic prophase in lily microsporocytes, while chromosomal RNA synthesis is maintained at high levels. While much of the nuclear RNA is transported to the cytoplasm during 24 hours of labeling, the nucleolus also, paradoxically, gradually accumulates large amounts of labeled uridine into RNA.

When RNA is extracted from whole cells and electrophoresed on polyacrylamide gels it is mostly ribosomal in type, but the labeled, *nascent* RNA is largely heterogeneous rather than ribosomal. Labeled RNA extracted from isolated nucleoli is apparently ribosomal (mostly 25s) in type, but RNA extracted from isolated ribosomes does not become labeled. Meiotic cells apparently limit the production of ribosomes through both transcriptional and maturation controls. Much of the nascent RNA accumulating in the cytoplasm is probably mRNA which must be translated on pre-existing ribosomes.

(186)

Systematic Studies of the Genus *Balduina* (Compositae)

EARL S. PARKER

The genus *Balduina* is composed of three species: *Balduina atropurpurea* Harper, *B. angustifolia* (Pursh) Robinson, and *B. uniflora* Nutt. All three species are indigenous to the Coastal Plain of the southeastern United States. The genus seemed promising for systematic studies, since no natural hybridization has been reported, although the three species are neighboringly sympatric in Georgia and Florida. The original descriptions indicate the major difference between *B. atropurpurea* and *B. uniflora* is the color of the disk corolla. An investigation of the genus was undertaken to gain information about the biological relationships among the three species. Local population samples were analyzed for morphological characters. This information was combined with data from studies of floral and leaf anatomy, chromosome counts and observations, experimental hybridization and ecology. Flavonoid, polyacetylene and sesquiterpene lactone compounds were isolated and identified to detect inter- and intra-specific differences among the taxa of the genus. Since *B. atropurpurea* and *B. angustifolia* are diploid and *B. uniflora* is a tetraploid, protein studies were made to determine the origin of the tetraploid condition.

(29)

A Recirculating System for Culture of Channel Catfish, *Ictalurus punctatus*

NICK C. PARKER AND BILL A. SIMCO
Memphis State University

A recirculating raceway system consisting of a biofilter box and three 275 gallon linear tanks were used for the culture of channel catfish. In addition, two 400 gallon circular tanks were located outside and connected to the indoor tanks. The outdoor tanks provided increased water volume and exposure to sunlight. Water was recirculated through the system at 36 gpm (12 gpm per linear tank). Scrap plastic material was used as filter media for the biofilter. It is inexpensive, light, provides extensive surface area, creates little resistance to water flow, and is a satisfactory surface for biofilter floral growth. A three inch layer of mussel shells and limestone was used as a buffering agent. Some fish mortalities were experienced from asphyxiation by mechanical obstruction of the gills due to a heavy algae bloom (0.045 grams dry wt. l) of *Scenedesmus dimorphus*. The outside tanks were disconnected and subsequently water proved satisfactory for fish growth during a four month period. Ammonia levels remained below 1 ppm. Three tanks were stocked with 45, 79, and 44 channel catfish. Average weight at the time of stocking on 3 Aug. and sampling data from 20 Dec. for each of the three tanks were respectively: 500 — 845, 90 — 355, and 85 — 530 grams. Growth was affected by stocking densities, size of fish on stocking and spawning behavior.

(82)

Effects of Aroclor® 1254, a PCB, on Oysters, *Crassostrea virginica* (Bivalvia: Protobranchia: Ostreidae) ¹

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Oysters were continuously exposed to Aroclor 1254, a polychlorinated biphenyl, in flowing, unfiltered sea water. Growth rate (height and in-water weight) was significantly reduced (Student's t-test; variation = 0.05) in oysters exposed to 5.0 micrograms/liter (ppb) for 24 weeks, but was not affected in oysters exposed to 1.0 ppb for 30 weeks. Mortality was not significant in any group. In oysters exposed to 5.0 ppb, greatest PCB residue (whole-body) was 425 milligrams/kilogram (ppm), a concentration factor of 8.5×10^1 , and a trace was retained after 32 weeks depuration in PCB-free water. In oysters exposed to 1.0 ppb, greatest residue was 101 ppm, a 10.1×10^1 concentration factor, and a trace was retained after 12 weeks depuration. Pathological examination of exposed oysters revealed degeneration of vesicular connective tissues concomitant with leukocytic infiltration. Tissue alterations were much greater in oysters exposed to 5.0 ppb, but tissue recovery seemed excellent after 12 weeks depuration.

¹ Contribution No. 141, Gulf Breeze Laboratory.

(249)

Preliminary Study of the Chromosomal Banding Patterns in Mongolian Gerbil (*Meriones unguiculatus*)

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The karyotype of Mongolian gerbil was studied, using fibroblasts derived from fascia. Fibroblasts were grown by short term tissue culture and chromosomes were stained for heterochromatin bands. Our results have shown that the diploid number of chromosomes for the Mongolian gerbil is 44, which confirms previous reports of investigators using bone marrow cells. Discrepancies in sex chromosomal morphology seems to be common in prior investigations. The employment of banding technique has produced distinctive chromosomal patterns which could lead to clarification of the complete karyotype in this species including possible intraspecific polymorphism.

(183)

A Scanning Electron Microscopic Investigation of the Spores of the Fern Genus *Cystopteris* Bernh. (Pteropsida: Filicales: Aspidiaceae)

RONALD W. PEARMAN, University of Tennessee

A preliminary investigation of spore architecture of several species of the fern genus *Cystopteris* Bernh. using scanning electron microscopy was undertaken in order to determine possible taxonomic significance. An emphasis has been placed on *Cystopteris protrusa* (Weath.) Blasdell, *C. bulbifera* (L.) Bernh. and their supposed hybrid *C. X tennesseensis* Shaver. Techniques for

specimen preparation used in the study are reviewed. The study reveals spore structure which are of taxonomic value. Differences in size of spores and architecture occur within a species, however, overall findings indicate distinct morphological differences at the specific and subgeneric levels within the genus.

(105)

Myxomycetes from Bark of Living Trees in Panola Mountain State Park

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Atlanta University

Throughout 1971 and the early part of 1972, bark samples were removed from living trees in Panola Mountain State Park, a preserved natural area located approximately 20 miles southeast of Atlanta. Samples were incubated in moist chambers to induce sporocarp development. Forty-two trees, representing five genera, viz., *Quercus*, (2 species), *Pinus* (2 species), *Carya*, *Cornus*, and *Liriodendron*, were used in this study. Twenty-two species of myxomycetes have been obtained from the bark samples collected. Single species representing the genera *Perichaena*, *Didymia*, *Lamproderma*, *Licea*, *Trichia*, *Metatrichia*, and *Echinostelium*, have been identified. Two species of *Didymium*, three species of *Cribraria*, *Physarium*, *Acyria*, and four species of *Comatricha*, have also appeared. The most ubiquitous species found in this study was *Echinostelium minutum*. This species has appeared throughout the year on bark of all trees. Some of the myxomycetes appear to have affinities for certain tree species. *Cribraria violacea*, e.g., has appeared mainly on bark of *Cornus*. Another *Cribraria*, *C. minutissima* has appeared throughout the year, but only on bark of *Pinus taeda*. Bark samples from *Pinus echinata* have yielded only *Echinostelium minutum* and *Comatricha nigra*.

(Research Publication No. 34 Atlanta University Center Science Research Institute.)

(188)

Systematics of *Chaetopappa* Series *Effusae* (Compositae-Astereae)

CHARLES H. PERINO, North Carolina State University

The *Chaetopappa* Series *Effusae* consists of three perennial species: *Chaetopappa effusa* (Gray) Shinnars occurs on the eastern edge of the Edward's Plateau of Texas, *C. keerlioides* Shinnars occurs in northwestern Coahuila, Mexico, and *C. parryi* Gray in Brewster County, Texas and northern Mexico. Shinnars noted that *C. keerlioides* "stands between" *C. effusa* and *C. parryi*. Analysis was done on fifty morphological characters of which ten are considered significant. These include such characters as style branches, another appendages, corolla lobes and phyllary apices. In addition, the remaining species of the genus, with one exception, were also examined in limited numbers for comparative purposes. The results indicate that *C. keerlioides* and *C. parryi* are closely related species. *Chaetopappa effusa* has few characters in common with the latter two species or any others of the genus. It therefore seems reasonable to segregate this taxon as a new genus.

(233)

The Fine Structure of "Rhizoids," Holdfasts,
and "Slimeways" of Thraustochytriaceous
Phycomycetes (Saprolegniales) and
Labyrinthulid Protozoa

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The fine structure of cellular extensions "rhizoids," holdfasts and "slimeways" was examined in *Schizochytrium aggregatum* and *Thraustochytrium motivum*, two species of thraustochytriaceous fungi (Order: Saprolegniales); one species of an unidentified coccoid fungus which resembles *S. aggregatum*; and two species of *Labyrinthula*, Protozoa of uncertain taxonomic affinities. Cellular extensions in all species were membrane bound, contained no organelles, and arose from similar cytoplasmic organelles at the cell surface. Arrays of the extensions were organized into net patterns. *S. aggregatum* and *T. motivum* appeared to use the extensions as holdfasts and as organelles for increasing cell surface area. The extensions appeared to be functionally similar in the other three species; however, they were also used in motility of non-flagellated, non-amoeboid cells. It is suggested that the labyrinthulids and thraustochytriaceous fungi are closely related and should be placed together in a new family of Protozoa. Phylogenetic affinities of the group remain uncertain.

(27)

Feeding Selectivity in Juvenile Atlantic Menhaden
Brevoortia tyrannus, (Pisces: Clupeidae)

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Laboratory experiments were conducted and field samples collected to determine if juvenile menhaden feed selectively. In the laboratory menhaden usually ingest suspended microscopic food. They will also consume material resting on the bottom, including particles up to 2 mm diameter. The fish readily consumed diatoms (5-50 μ) and detritus particles (natural silt and ground spartina ranging from 1-100 μ), when diatoms and detritus were fed simultaneously both were ingested with the larger particles selected more frequently.

In field studies water samples and fish were collected simultaneously at several estuarine locations. Analysis of the percentage ash in suspended material and fish gastrointestinal tracts indicate that the fish consume primarily mixed plankton while avoiding inorganic particles. The laboratory experiments indicate this selective feeding may be related to particle size i.e. avoidance of the smaller inorganic silt particles.

(219)

The Effect of Salinity on Plasma Na^+ , Cl^- ,
Hematocrit, Total Solids and Total Proteins of
Ictalurus punctatus (Teleostei: Ictaluridae)

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Memphis State University

In recent years the increase in interest in fisheries biology has led to intensified research concerned with environmental effects upon mortality and growth of commercially important fish. From February, 1971,

through December, 1971, a series of experiments was carried out to determine the effects of various salinities upon the blood properties of Channel Catfish, *Ictalurus punctatus* (Rafinesque). Fish were exposed to concentrations of 0, 4, 8, 10, and 12 parts per thousand NaCl for five days during five separate experiments. Ten parts per thousand was used to determine the effect of an extended period of exposure. Results indicate that there is an initial increase in plasma Na^+ and Cl^- and a drop in the hematocrit. Total solids and total protein concentrations vary in result. Following the rise in Na^+ and Cl^- concentration a return to the normal level was seen by ten days.

(239)

Some Interactions Within Four Species
of *Anabaena*

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We grew *A. affinis*, a euplankter; *A. ambigua*, an aquatic form; and *A. cylindrica* and IUCC 1444 *A. flos-aquae*, both of which we regard as amphibious; singly and in different combinations under a variety of cultural conditions. Typically, *A. affinis* grows as needle-like, gas vacuolated filaments; *A. ambigua*, as short active hormogones; *A. cylindrica*, in very long diffuse filaments; and *A. flos-aquae*, as small entangled tufts. Generally, in shaken cultures, *A. flos-aquae* (or when *A. flos-aquae* is absent, *A. cylindrica*) eventually became dominant regardless of other conditions. Under continuous illumination, *A. affinis* usually prevailed for short growth periods up to six days. Despite its seemingly favorable growth form, *A. ambigua* seldom became a major component of any combination. Although each species has different rates of nitrogenase activity, the presence or absence of combined-nitrogen in the culture medium had little effect. Possibly because of some clumping tendency, agitation of the growth medium provided most benefit to the two amphibious species. The comparatively poor development of the euplanktonic *A. affinis* under 12-hr illumination suggests to us that day-length may be a significant factor in water-bloom outbreaks.

(325)

Speciation and Host Range in *Orobancha*
ludoviciana of the Mississippi River System

MARTIN A. PIEHL, Louisiana State University

The importance of host range in the evolution of parasitic flowering plants is often difficult to detect, particularly since host data from the literature and herbarium sheets are often sparse or inaccurate. In what can be tentatively called the "eastern variant" of *Orobancha ludoviciana* Nutt., sens. lat. (Orobanchaceae), field studies of its host range indicate its hosts to be generally different species than for western *O. ludoviciana*. The hosts, and as to be expected, the parasite, are annual, while at least the majority of hosts are perennial in the west. Further study has shown the habitat and probably flowering date to be distinct, and that there exists some morphological distinctiveness.

(117)

Electrophoretic Differentiation of the Parotoid Venoms of *Bufo americanus americanus* and *Bufo woodhousei fowleri* (Amphibia, Anura, Bufonidae)

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AND MICHAEL J. HARVEY
Memphis State University

Parotoid venoms of *Bufo americanus americanus* and *Bufo woodhousei fowleri* were differentiated using vertical polyacrylamide gel electrophoresis. Parotoid venom was expressed manually from the parotoid glands of live toads. The venom was dissolved immediately in buffer and applied to the electrophoretic gel. Separation of the sample was carried out for 2 hr at a constant voltage of 300 v and a constant temperature of 0°C. Gels were stained using a general protein stain (Amido Black 10B). Specimens of *Bufo americanus americanus* and *Bufo woodhousei fowleri* were obtained from areas where the ranges of the two species do not overlap. This was done to insure that specimens free from possible hybridization were used to establish electrophoretic patterns. Specimens were maintained as living stocks in the laboratory. Electrophoretic differences between the venoms of the two species were demonstrated. These differences were evident both visually and on densitometer readings of the electrophoretic gels. The most apparent difference was evident in bands composed of the more rapidly migrating components of the venom.

(141)

Seasonal Studies of Parasitism on the Cattle Egret, *Bubulcus ibis*, by the Nasal Mite, *Neonyssus* (Acarina: Rhinonyssidae), and the Hypophial Nymph, *Hypodectes* (Acarina: Hypoderidae)

VERNON N. POWDERS, Georgia Southwestern College

During 1969-71 the incidence of nasal mite, *Neonyssus*, and hypophial nymph, *Hypodectes*, infections in 402 cattle egrets, *Bubulcus ibis*, was studied. *Bubulcus ibis* were collected in Crisp, Dooley, and Sumter Counties, Georgia and Alachua, Marion and Osceola Counties, Florida. Due to migration, *B. ibis* collections were limited to Florida during the winter. The infection rate throughout the study was 31 per cent for *Neonyssus* and 58 per cent for *Hypodectes*. Both *Neonyssus* and *Hypodectes* infection rates were comparable in Georgia and Florida. Incidence was rather constant during the spring and summer but decreased in the fall. *Neonyssus* reaches a low incidence during the winter. *Hypodectes* infection rates appear to return to normal, i.e., those rates of the previous summer, during the winter. There was no apparent differences in per cent occurrence from year to year if collections were made at comparable times during the season. Possible mechanisms to explain fall and/or winter reductions in parasitism will be discussed. (This study was supported in part by a Chapman grant from the American Museum of Natural History.)

(8)

Some Advantages and Disadvantages of a Multiple-Plate Conservation Webbing Artificial Substrate as a Supplement to Hand Collecting of Macroinvertebrates in Chesapeake Bay

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AND
SAMUEL L. H. FULLER AND C. W. HART, JR.
Academy of Natural Sciences of Philadelphia

In the Chesapeake Bay intertidal zone, the use of an artificial substrate composed of irregularly spaced, alternating layers of conservation webbing and hardboard attracted certain invertebrate groups (e.g., Crustacea: Amphipoda) in greater numbers than are ordinarily encountered in hand collections. This fauna was compared to hand collections made concurrently. Although certain organisms (e.g., larger Crustacea and Mollusca) which are normally encountered during hand collecting did not inhabit this device, it is recommended as a supplement to hand collections in that it offers inexpensive, long-term quantitative monitoring of certain macroinvertebrate groups in ecological surveys.

Work supported in part by the Baltimore Gas and Electric Co., Baltimore, Md.

(32)

Studies on the Opening of the Hypocotyl Hook

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It was previously reported that the light induced opening of the hypocotyl hook was inhibited by the cotyledon in bean and stimulated by these organs in cotton. Several other species were tested and it was found that the effect of the cotyledon resembled that of bean rather than cotton. Therefore different varieties of cotton were tested. In general the cotyledons increased the light-induced hook opening but the magnitude of the response differed. In addition, in cotton, the root also stimulated light-induced hook opening. In the dark, a complex relationship existed between the roots and cotyledons and hook opening. In the absence of cotyledons the hooks opened more in the dark than in the light, and in one variety a maximum opening occurred in the dark with the roots attached and the cotyledons removed. The opening response is also affected by temperature. These relations will be discussed.

(45)

Visualization of Phytochrome with the Electron Microscope

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We have succeeded in visualizing phytochrome with the electron microscope by an extension of an immunocytochemical assay previously used with the light microscope. The assay involves the fixation of etiolated oat coleoptiles in formaldehyde followed by rapid embedding with polyethylene glycol. Sections 20 μ m thick are then sequentially incubated in the following reagents: rabbit anti-phytochrome serum, sheep anti-rabbit immunoglobulin serum, and rabbit antiperoxidase-oxidase complex. The result is the immunospecific

attachment of peroxidase to the tissue section wherever immunochemically active phytochrome is located. Peroxidase is then visualized by incubation with diaminobenzidine and hydrogen peroxide. The reaction product (oxidized diaminobenzidine) is readily observed with the light microscope and, by incubating with osmium tetroxide, may be visualized with the electron microscope. Our initial observations lead to two conclusions: 1) phytochrome may be visualized with the electron microscope in cells which have too little phytochrome to be seen with the light microscope and 2) there is an apparent specific association of phytochrome with the plasmalemma in those cells which have only a minor concentration of the chromoprotein.

(278)

Molting of the Crayfish *Orconectes immutis* (Hagen) in Relation to Temperature, Photoperiod and Light Intensity

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Western Kentucky University

Results are based on three 90-day experiments: January-March, 1971 (Exper. 1); June-August, 1971 (Exper. 2 & 3). Each experiment was based on a 3 by 3 design and utilized 144 adult animals. Data were analyzed using a completely randomized design. Temperatures and photophases for each experiment were 14 C, 18 C, 22 C and 6 hrs., 15 hrs., and 24 hrs. In Experiment 3 all factors were equal except that light intensity at the water surface was about 15 fc, whereas in the first two experiments light intensity was about 120 fc.

In Experiment 1 all animals at least attempted to molt and some molted 3 times. Significantly more molting occurred at 22 C and virtually all animals died in molt (E_s) at 14 C, with an overall mortality of about 50%. There was no significant photoperiod effect and therefore no interactions between photophase and temperature were detected. Results of Experiment 2 were similar except that there were virtually no mortalities and only about 50% of the animals molted. In Experiment 3 molting frequencies were lower in 15 fc light than in 120 fc light at 14 C and 18 C but higher in 15 fc light than in 120 fc light at 22 C.

(115)

A Preliminary Investigation of the Intestinal Tract Dimensions of Turtles (Reptilia: Testudines)

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AND MARGUERITE M. JACKSON
Mississippi State College for Women

A dimensional analysis was made of the intestinal tracts of various species of turtles. The objective of the investigation was to determine the relative and absolute sizes of the small and large intestines, and the length ratio of the small intestine to the large. The influence of age (body size) on the dimensions and ratios of the gut was investigated. Small intestine/large intestine ratios are uniformly constant, revealing no ontogenetic changes but pronounced interspecific differences. High linear correlations ($>.94$) between the subdivisions of the intestinal tract and age (size) were found in all taxa examined, and interspecific differences were marked.

(261)

Development of Color Pattern in Pond-Reared Young of Five Bass Species (*Micropterus*) of Southeastern U. S.

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Auburn University

Six stocks of southeastern *Micropterus* spawned in earthen ponds, including wild-caught adults of *M. coosae* (Alabama and Apalachicola races), *M. p. punctulatus*, *M. punctulatus henshali*, *M. notius*, and hatchery stock of *M. dolomieu* (White River population). Young were reared in earthen ponds provided with minnow forage. Samples were preserved periodically to determine pigmentation characteristics at different ages and sizes. Wild-caught young of *M. salmoides* were included for comparison. An illustrated key to species was constructed based on juvenal color patterns. Juvenal specimens were defined as those lacking complete melanistic pigmentation at the posterior margin of the caudal fin. Development of color pattern was most similar at all stages in *M. salmoides* and *M. punctulatus* and in *M. coosae* and *M. dolomieu*, while pattern development in *M. notius* was intermediate between the groups. Phenotypic differences between parental stocks persisted in young spawned and reared under similar pond conditions.

(2)

Ecological Genetics of *Peromyscus polionotus* (Mammalia: Rodentia) and a Model of Population Regulation

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Savannah River Ecology Laboratory

It is proposed that the level of heterozygosity in populations interacts with density and a breeding system to cause fluctuations in natural populations. Correlation exists between reproductive rate and average individual heterozygosity in populations of *Peromyscus polionotus*. Geographic patterns of heterozygosity and the fluctuations in density of local populations support a model of population regulation which includes:

- (1) the constant reproductive superiority of relatively heterozygous animals, and
- (2) a breed system of cyclic inbreeding and outbreeding which causes fluctuations in the relative proportions of these animals.

Data on biochemical polymorphisms and a light brown phenotype in this species will be presented.

(243)

Scanning Electron Microscopy of Living Wild Type and Mutant *Drosophila melanogaster*

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and University of Alabama in Birmingham

Observation of living *Drosophila* affixed to scanning electron microscope (SEM) stubs with silver conductive paint revealed subtle morphological differences between wild type and selected mutant organisms. Particularly interesting are variations in eyeless individuals which appear sporadically in cultures derived from ethylmethanesulfonate-treated flies. The observed variations represent non-heritable "fractional" mutations and their

expression ranges from bilateral total absence of ommatidia to unilateral partial reduction in eye size. Unexpectedly, some flies removed from the SEM were alive, although they had been exposed for one hour to a high velocity electron beam and a negative pressure of 10^{-6} torr. Using an apparatus producing a 10^{-8} torr vacuum, we have established that *Drosophila* survive such conditions for up to seven hours. Recovery after exposure to the internal environment of the SEM suggests that high resolution observations may be made on individual flies both before and after various experimental manipulations.

(225)

A Simplified Method for Performing Pinealectomies On Small Mammals

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In recent years the pineal gland has come to be regarded as a highly significant endocrine organ. It has been suggested to function for example, in control of circadian rhythm patterns as would pertain to its regulation of the synthesis and uptake of certain biogenic amines in the organism. Hence there has been an increase in the need for the surgical excision of the pineal in assaying its function.

A pinealectomy technique has been devised which requires a minimum of time, equipment and expense. It involves the use of ether as an anesthetic and a 0.2% nitrofurazone solution for antiseptic treatment. Otherwise, all that is required is an ordinary variable speed drill with saw attachment and an inexpensive dissecting kit. A useful optional item is a head holding device which may be easily constructed from a small block of wood, a piece of wire and some screws.

The results from using this technique have been very encouraging. The pinealectomies have required an average of 15 minutes to complete. There has been a minimal loss of blood and the survival and recovery rates have been good.

(310)

Vegetation of the Supra-Littoral Margin of Escambia Bay

DWAINE T. RAYNOR AND JOE A. EDMISTEN

The vegetation around Escambia Bay, Florida was sampled and mapped. Over a two year period remote sensing and ground truth samples, utilizing nested quadrats and bisects in the major vegetation types encountered, were employed. The sampling indicated the existence of seven vegetation types: (1) sandy beach, (2) salt marsh, (3) hardwood swamp, (4) eroded bluff, (5) flatwoods, (6) mesic hammock, and (7) sand hill. A representative profile was drawn for each vegetation type. Compilation and calculation of relative frequency, relative dominance, relative density, and importance values were performed. A comparison and correlation between vegetation type, topography, and soil type was demonstrated.

(109)

Epidermal Morphogenesis on Dead Dermis

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Previous studies have shown that either living or dead dermis will maintain adult human epidermis or 12-day chick embryo epidermis. The intent of the present study was to determine whether dead dermis could induce differentiation of mouse embryo ectoderm. Dermis isolated from 4-week-old mice was killed by the freeze-thaw method and then cut into small pads. Ectoderm was removed from the limb buds of 10-day mouse embryos by cold trypsin separation. The ectoderm was associated with the dermal pads in normal orientation and transferred to the chorioallantoic membrane of host chick embryos. By transfer, the explants were cultivated up to 18 days before recovery. Histological examination revealed that the ectoderm had differentiated and produced a stratum corneum. Thus dead dermis not only is able to maintain an intact epidermis, but also allows the morphogenesis of embryonic ectoderm into epidermis. (Aided by a grant from the UR Research Fund)

(263)

The Recovery of Fish Populations From the Effects of Acid Mine Drainage in the North Anna River

JAMES R. REED, JR., *Virginia Commonwealth University*

Studies showed that fish populations in the North Anna River, Virginia were affected by acid mine drainage for as much as 30 miles downstream from the source of the effluent. The effects were not due to gross deterioration of water quality but rather to secondary causes such as limited macrobenthic food organisms and spawning sites as well as occasional slugs of heavy metals at times of high water. The fish populations appeared to recover below the fall line but a specific biological recovery area for the river could not be defined solely on the basis of fishes.

(298)

The Influence of Vacuole Formation on Gametophyte Development in Angiosperms — A Postulate

JOHN D. REYNOLDS, *Virginia Commonwealth University*

The influence of the vacuole in determining the manner in which a cell may, on the one hand, give rise to maleness or femaleness as expressed by its development into a male and/or female gametophyte or remain vegetative will be discussed.

(197)

A Preliminary Appraisal of Wildlife Habitat Provided by Cottonwood (*Populus deltoides*) Plantations in the Mississippi Delta

MICHAEL W. ROBERTS, *Mississippi State University*

Basic changes in understory plant communities associated with one, two, eight and eleven year cottonwood plantations and the natural hardwood forest in the delta

batture of Washington and Bolivar Counties, Mississippi, were studied. Rectangular quadrats, 1/10,000 of an acre, were placed two chains apart along the longest diagonal of each study area and all plants within the quadrat were identified and counted. Young plantations of one to three years of age were dominated by low, dense stands of grasses. Older stands generally had a reduction in these seed producers and an increase in broad-leaved plants such as *Eupatorium* sp. and *Erigeron* sp. Stands over eight years had an increase in *Tovara virginiana* and *Panicum* sp. *Tovara virginiana* was the dominant species in the natural hardwood forest. Possible implications to wildlife are discussed.

(76)

Dating Recent Reservoir Sediment Using Radioactive Fallout ¹

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AND ANGELA C. GILL²

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Since quantitatively sediment is the largest pollutant of our nation's waters, dating recently deposited sediment and estimating recent sedimentation rates is important to the understanding of the processes which are taking place in our reservoirs and lakes. The purpose of this paper is to describe how radioactive fallout ¹³⁷Cs may be used to date sediment deposited since 1959.

Within a small watershed, fallout ¹³⁷Cs is assumed uniformly distributed on the surface soil. The ¹³⁷Cs is then tightly absorbed to the surface soil particles. Some of these "tagged" soil particles then move through the sedimentation cycle and may be used to date sediment profiles. Two distinct periods of erosion and sedimentation (1959-60 and 1963-64) can be correlated with periods of maximum atmospheric fallout. Data from reservoirs with a known sedimentation history are used to illustrate the utility of this method.

¹Contribution of the U.S. Sedimentation Laboratory, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, in cooperation with the University of Mississippi, the Mississippi Agricultural Experiment Station and the U.S. Atomic Energy Commission [Contract 49-7(3029)]

²Botanist, Research Chemist, and Chemist respectively, Oxford, Miss.

(47)

Studies on Stomatal Frequency and Distribution in *Gossypium hirsutum* L.

I. Cultivars Developed on the Texas High Plains ¹

BRUCE ROARK AND J. E. QUISENBERRY²

Studies were conducted on the frequency and distribution of stomates on different structures of the cotton plant. Stomatal counts were obtained by applying a thin layer of fluid plastic to the plant structures, peeling the dried film from the structure, and photographing the impressions. The photographs were projected onto a screen in order to count the stomates.

Four current and four obsolete varieties of cotton were studied. The four current varieties had been derived by selecting adapted genotypes from the four obsolete varieties. The obsolete varieties used were not adapted to cultivation on the High Plains of Texas. The purpose of the study was to determine if selection for adaptation to the High Plains of Texas involved a change in the frequency or distribution of plant stomates,

The results of this study are explained in a series of photomicrographs and conclusions are drawn concerning the changes in stomatal frequency and distribution.

¹Contribution from the Plant Science Research Division, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the Texas Agricultural Experiment Station, Lubbock, Texas.

²Plant Physiologist and Research Geneticist, respectively, Plant Science Research Division, Agricultural Research Service, U.S. Department of Agriculture, RFD 3, Lubbock, Texas. 79401

(295)

The Floral Apex of *Illicium floridanum* Ellis (Dicotyledonae, Ranales, Illiciaceae)

RICHARD EARL ROBERTSON, Louisiana State University

The pattern of floral apical development in *Illicium floridanum* Ellis is significant because of the alleged phylogenetic primitiveness of this Ranalian member. Both height and width of the floral apex increase between initiation of the three tepal tiers, the two stamen tiers, and the whorl of uniovulate carpels. Apical configuration consists of a multi-layered tunica, a central mother cell zone, a rib meristem, and a peripheral zone. After initiation of the carpels the apex continues to increase in both size and width. Cells on the flanks divide, building up the sides of the apex; maximum size of the apex approximates 500 μ wide by 300 μ high. Cell divisions in all layers of the apex account for the increase in the size of the apex after carpel initiation. The apical residuum matures as the carpels attain a height of 1400 μ , and ovular development assumes a prominent role.

(303)

Shrub-Tree Communities of a Granite Outcrop

SHARRON E. ROGERS

Shrub-tree communities were studied on Panola Mountain, an undisturbed granite monadnock 20 miles southeast of Atlanta, Georgia. Nine permanent 100 m² quadrats were established, including three examples each of stands of pine, mixed, and hardwood species. Vegetational analyses and edaphic studies were made. Subsequent community ordination studies indicate pine and mixed stands are quite similar. Composition of hardwood stands was considerably different. Edaphic conditions proved similar for all stands with the major exception of soil depth. Pine and mixed stands had maximum depths ranging from 75 to 85 cm., while hardwood stands ranged from 100 to 125 cm.

These shrub-tree communities represent a distinct island community type, with soil depth being the primary limiting factor. Thus, they occupy a terminal position in the previously established pattern of communities, which correspond in their increasing complexity with increasing soil depth. These are: Diamorpha, lichen-annual herb, annual-perennial herb, and herb-shrub communities.

(26)

Size and Sex Segregation of Offshore Hake, *Merluccius albidus* (Mitchill) in the Gulf of Mexico

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National Marine Fisheries Service

Mean size of offshore hake, *Merluccius albidus*, increases with increasing depth on the upper Continental Slope in the Gulf of Mexico. Sexes are segregated in respect to depth with nearly all male *M. albidus* being found in depths of 300 fathoms or less whereas females occur throughout the known bathymetric range of the species. Relationship between increasing size of individual hake and segregation of sexes on the De Soto Canyon Slope in reference to bottom temperature is discussed.

(54)

Isolation of Intact Mesophyll Cells from a Crassulacean Acid Metabolism (CAM) Plant *Sedum telephium*

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For metabolic studies with mature photosynthetic tissue of higher plants it is desirable to have separated cells in a liquid suspension so that they could be handled much like unicellular algae. The successful isolation of distinct cell types from mature leaves of crabgrass and spinach has been reported (Edwards, G. E., and C. C. Black, 1971, *Plant Physiol.* 47, 149-156). However, there seems to be no report on isolation of metabolically active leaf cells from CAM plants.

A technique will be described for the separation of mesophyll cells (MC) from leaves of *S. telephium* and microscopic evidence of separation will be presented. Gentle grinding with a mortar and pestle (at 4°C) of mature peeled leaves was used to separate intact MC. Cell counts under a light microscope, in typical preparations, indicated from 50 to 65% of the MC were intact and chlorophyll yield was between 0.9 to 1.2% which is in line with previous yields from spinach. The ratio of chlorophyll a to b was 2.63.

These isolated cells are capable of photosynthetic ¹⁴CO₂ fixation at rates between 4 and 10 μmoles of CO₂/mg chl/hr. By adding 1mM ATP and 5mM ribose-5-P or 5 mM ribulose-1,5-diP rates of 30 and 45 μmoles CO₂/mg chl/hr, respectively, were obtained. Pyruvate plus ATP, glyceraldehyde 3-P, and 2-phosphoglyceric acid also were active as substrates for CO₂ fixation. By adding phosphoenolpyruvate (PEP) rates of 150 μmoles CO₂/mg chl/hr were obtained. The K_m of PEP for these cells was 0.7 × 10⁻³ M and the E_a was 11.3 kcal.

(190)

Morphology and Anatomy of the Genera *Amphipappus*, *Amphiachyris*, *Greenella*, *Gutierrezia*, *Gymnosperma*, *Xanthocephalum* and *Thurovia* (Compositae)

JOHN RUFFIN, Atlanta University

The question of whether *Amphipappus*, *Amphiachyris*, *Greenella*, *Gutierrezia*, *Gymnosperma* and *Xanthocephalum* (Compositae) should be segregated at the generic level or maintained as a single coherent genus has long been problematical. The relationship of the genus *Thurovia* to the latter genera has also been questioned. A clear concept of the genera represented here was not perceived by earlier investigators due at least in part to the few species then known cytologically as well as morphologically. As a consequence the present investigation was undertaken to: (a) reevaluate the taxonomic position of the genera by attempting to quantify and assess the gross morphological variation between the various groups, (b) to conduct a comparative anatomical study to determine whether endomorphic characters support the relationships suggested by gross morphology and cytology and (c) to determine phylogenetic or evolutionary relationships from anatomical data. Wood studies, floral and recent cytological findings support the merger of *Xanthocephalum*, *Gutierrezia* and *Greenella* into one coherent genus while maintaining *Gymnosperma*, *Amphipappus* and *Thurovia* as distinct genera.

(50)

Selection Techniques for Determining High Photosynthetic Efficiency as Deduced from the Gas Exchange of Oats and Soybeans ¹

Y. B. SAMISH AND J. E. PALLAS, JR.²

The loss of CO₂ from leaves under conditions which favor photosynthesis is attributed to photorespiration. The rates of photorespiration and resistances to gas exchange of 40 genotypes of oats and soybeans have been calculated from the measurements made by Dornhoff, Shibles, and Criswell, 1971. From these calculations it is apparent that when the resistance to gaseous transfer through the stomates (R'_w) decreases, CO₂ efflux increases. This serves as confirmation of calculations and conclusions published by the senior author in 1968.

When the resistance of the mesophyll to CO₂ uptake decreases, internal photorespiration increases. This suggests that a common limiting factor (which might be the activity of ribulose diphosphate carboxylase) is limiting both photosynthesis and photorespiration. Such a suggestion is in opposition to present ideas in the selection of more efficient plants which consists of looking for low rates of photorespiration as indicated by low CO₂ compensation concentrations.

Our calculations indicate that the selection for plants with higher photosynthetic production potential should include low stomatal resistance and high rates of photorespiration.

¹ Contribution from the Southern Branch, Soil and Water Conservation Research Division, Agricultural Research Service, USDA, in cooperation with the University of Georgia, Agricultural Experiment Station. For presentation at Southern Section of the American Society of Plant Physiology, Mobile, Ala.

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(144)

Preliminary Effects on Algal Succession Resulting from Nutrient Enrichment of Two Central Virginia Ponds With Different Trophic States

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The effect of nutrient enrichment (accelerated eutrophication) on algal succession was studied on two adjacent, morphologically similar central Virginia ponds with different trophic states (one already receiving animal waste effluent was eutrophic, the other unenriched was oligotrophic). A comparison of phytoplankton development and nutrient levels in the two ponds was established prior to the diversion of effluent wastes into the oligotrophic pond. The eutrophic pond's higher trophic status was induced by sewage effluent. Each pond contained a distinctive algal flora; the organically enriched waters of the eutrophic pond supported large populations of blue greens, diatoms and flagellates while the nutrient poor oligotrophic pond contained lower numbers of phytoplankton and a paucity of green algae, desmids, and dinoflagellates. After diversion of wastes into the as yet unenriched oligotrophic pond, the ponds were closely monitored to observe changes in algal flora and trophic levels. Throughout the study the biological productivity of both lakes was determined periodically by measuring $^{14}\text{CO}_2$ uptake, total extractable chlorophyll, and the relative dominance of the algal genera in order to evaluate changes in trophic level. A series of *in situ* field and laboratory studies were conducted to determine which nutrients caused accelerated algal growth. The study offered a unique opportunity to follow the effect of nutrient enrichment on algal succession from the onset of eutrophication.

(191)

Investigations on Nutrient Factors Limiting Phytoplankton Productivity in Two Central Virginia Ponds

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Laboratory and field studies were initiated to evaluate at regular intervals by ^{14}C and chlorophyll enrichment bioassay some of the nutrients, particularly ammonia, that might limit phytoplankton photosynthesis in two Central Virginia ponds. Preliminary comparisons of the phytoplankton, their production, and the chemical characteristics of the water were determined. Ammonia, phosphates, nitrate, iron, carbonate and bicarbonate, silica and chloride differed most markedly among the various nutrients analyzed. Investigations were continued to compare the validity of using field and laboratory ecosystem work to predict changes in trophic levels resulting from nutrient enrichment, i.e. eutrophication. Laboratory experiments using aquatic microecosystems and field experiments employing *in situ* plastic cylinders and battery jars support the view that ammonia is a key factor regulating "trophic" features in these two ponds.

(270)

Some Factors Which Influence Physiological Color Change in Leeches and Observations on the Evolution of the Response (Annelida: Hirudinea)

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AND
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An investigation of some factors which influence color changes in the freshwater leech *Theromyzon tessellatum* and the marine leech *Calliobdella carolinensis* was carried out using the Hogben and Slome chromatophore index. Both the red-brown and the brown-black chromatophores disperse their pigments in the light and concentrate them in the dark. The leeches do not background adapt but respond to changes in light intensity. The role that temperature plays in the response was also examined, but with equivocal results. Ligation experiments on *C. carolinensis* suggest that a hormonal (or a humoral and hormonal) mechanism is involved in the response.

The following species representing the four major families of leeches were examined for color changes, using the Hogben and Slome chromatophore index: Glossiphoniidae, *Theromyzon tessellatum**, *Glossiphonia complanata**, and *Helobdella stagnalis*; Piscicolidae, *Piscicola geometra**, and *Calliobdella carolinensis**; Erpobdellidae, *Erpobdella octoculata*; and Hirudinidae, *Haemopsis sanguisuga*. Only those indicated by asterisks clearly showed physiological color change. These results and more casual observations on ten other species suggest that the response evolved *de novo* in the Rhynchobdellae.

(14)

Reproduction and Fat Body Cycle of *Cnemidophorus tesselatus*

JAMES G. SAXON, Erskine College

In 1967 and 1968 a study made in Presidio, Texas showed that the checkered whiptail, *Cnemidophorus tesselatus*, emerges from hibernation in April and May. Most adult females show signs of egg development soon after emergence, and lay the first clutch in May or June. A second clutch is laid by late July. No more than two clutches are produced. The average number of eggs per clutch is 3.7. Larger lizards tend to lay more eggs. Females of intermediate size are the most numerous adults. Most females reach sexual maturity in 13 to 14 months. Lizards start to hibernate in August and continue to do so until late October. A study of the cycle of fat bodies reveals that these structures are primarily used for the development of the first clutch of eggs.

(28)

An Analysis of the Atlantic Menhaden, *Brevoortia tyrannus*, (Pisces: Clupeidae) Purse-Seine Fishery, 1955-69

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To determine the effect of purse-seine fishing on the Atlantic menhaden (*Brevoortia tyrannus*) population, we analyzed data from 1955-69 on fishing activity and

catches. Changes in fishing efficiency necessitated establishment of an abstract effort unit, the 1965 vessel-week. Catch per unit of effective effort in 1965 was one-fifth that of 1955. Our instantaneous natural mortality rate (M) estimate was 0.37. At the current recruitment age, 1.5 years, reducing F, instantaneous fishing mortality, to about 0.8 would slightly decrease the yield per recruit, but would increase the spawning stock and ultimately allow annual catches of 400,000-500,000 metric tons, the maximum sustainable yield.

(312)

Elemental Analysis of Turtlegrass, *Thalassia testudinum* (Hydrocharitaceae) *

P. B. SCHROEDER, *University of Miami*

Elemental analyses were made on various parts of the tropical marine angiosperm, *Thalassia testudinum*, collected at La Parguera, Puerto Rico. Carbon, hydrogen and nitrogen were determined in roots, rhizomes, green leaves, vertical shoots, sheathing leaves, leaf base meristem, rhizomal growing tips and floral primordia. Green leaves, vertical shoots, roots, rhizomes and sheathing leaves were analyzed for cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, nickel, zinc and total phosphates. Results were subjected to analysis of variance. Comparisons are made to concentrations of trace elements found in the sea water, river waters and sediments in the area where the plant material was collected. The role of the plant in concentrating certain elements in the marine and estuarine environments is discussed.

* Research supported by NIH Training Grant ST01 ES00126 from the National Institute of Environmental Health Sciences and by the Puerto Rico Nuclear Center.

(169)

Thymidine Phosphorylation in Wheat ¹

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There may be at least two mechanisms of phosphorylating thymidine in wheat. It has been shown that ATP can act as a phosphate donor in the production of thymidine monophosphate (TMP) from thymidine. This finding, together with other biochemical data, suggested that a single enzyme, thymidine kinase, catalyzed the reaction. We here report an alternate mechanism of TMP production, in which AMP serves as the phosphate donor in a reaction presumably catalyzed by a nucleoside phosphotransferase. In wheat, AMP is at least as effective as ATP as a phosphate donor in TMP formation from thymidine. We therefore suggest that the nucleoside phosphotransferase pathway is a major mechanism of thymidine phosphorylation in wheat.

¹ Research sponsored by the U. S. Atomic Energy Commission under contract with the Union Carbide Corporation.

(212)

Host-Parasite Relationships: Metazoan Ectoparasites of the Grey Mullet, *Mugil cephalus*

DONALD E. SCOTT, *University of West Florida*

Three hundred ninety-one fish were taken from nursery areas in Escambia and Perdido Bays. Each fish was necropsied and the site of each parasite recorded as well as host size and condition. Environmental conditions of each area were obtained. One argulid, one copepod, two monogenetic trematode and two leech species were recovered from the gills and external surfaces of the host specimens. Preliminary statistical analyses have been completed examining the effects of host size, presence or absence of other parasites and environmental factors on the infection of each parasite. Results indicate a direct correlation between host length and number of gill parasites. Also indicated is an enhancement of the infection of the copepod by one of the monogenetic trematodes. Both the percentage of hosts infected and intensity of infection by all gill parasites increased sharply in the spring and after remaining relatively constant throughout early summer decreased sharply in mid-July.

(175)

The Purification and Properties of Arginase from *Canavalia ensiformis* (L.) DC. Seeds

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The arginase from jack beans, *Canavalia ensiformis*, has been purified by a pyridine treatment, followed by two precipitations with polyethylene glycol (Carbowax-6000), a precipitation with ammonium sulfate and DEAE-cellulose chromatography. This has given a preparation with a specific activity of more than 1400 mU/mg. The properties, including optimum temperature, pH, sensitivity to inhibitors, and substrate affinity of the purified enzyme will be discussed.

(63)

Chlorophyll Production in Mustard Seedlings

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Effects of various nitrogen sources on chlorophyll production in three-day old mustard seedlings and cotyledons show that ammonium nitrate, urea, and arginine at 10^{-3} M increase chlorophyll production by 5-15 percent. Kinetin (200 μ M), thiourea and canavanine (both at 10^{-3} M) inhibit chlorophyll production by 10-60 percent. The positive effects of arginine at 10^{-3} M can be balanced by canavanine at about 5×10^{-4} M and thiourea at a concentration of 5×10^{-3} and 10^{-2} M. However, the inhibitory effect of kinetin (200 μ M) on chlorophyll production cannot be overcome by arginine. This is not surprising because arginine and other nitrogen sources have different roles in cell metabolism than kinetin. The latter acting as a growth regulator is known to affect the nucleic acid metabolism. If this is true, than an anticytokinin factor may reverse the inhibitory effect of kinetin on chlorophyll production.

In our studies on chlorophyll production, thiourea behaved in a manner more like kinetin. Data on urea-thiourea and arginine-canavanine interactions are discussed in support of their mechanism of action in mustard seedlings.

(324)

A New Genus in the Frullaniaceae (Hepaticae)

A. J. SHARP, *University of Tennessee*

Presented by title. No abstract available.

(297)

A Technique for Determination of Stage and Section Plane in Electron Microscope Studies of Ovule Development

HARRY E. SHEALY, JR., *University of South Carolina*
J. M. HERR, JR., *University of South Carolina*

The precise nature of electron microscopy requires that the investigator know the approximate stage of ovule development and be able to select the appropriate section planes. For determination of developmental stages, the fresh ovary was divided into two portions which were fixed separately, one in FPA₅₀ and the other in cold glutaraldehyde. Within twenty-four hours the ovary in FPA₅₀ was transferred to "4½" clearing fluid. Dissected ovules mounted on slides beneath supported cover glasses were examined with phase contrast optics to determine developmental stages. Once ovules of a desired developmental stage were located, the corresponding portion of the ovary in glutaraldehyde was then post-fixed, dehydrated, and infiltrated. The ovules were transferred with a small amount of liquid embedding medium to flat depressions drilled into blocks of cured medium and then were oriented with microneedles to an appropriate section plane.

(260)

Fate of the Follicular Epithelium in the Developing Oocyte of *Dorosoma petenense* (Osteichthyes, Clupeiformes, Clupeidae)

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In most fishes the follicular epithelium has been reported to rupture at ovulation, releasing the egg prior to deposition, but in *Dorosoma petenense* it was present around the ovulated egg and was retained as the outermost membrane after deposition. The follicular epithelium underwent a series of chemical and morphological changes during the development of the oocyte. Prior to ovulation, its cellular nature degenerated to a radially, laminar layer. This layer surrounded the ovulated egg in the ovarian lumen and was retained as the outermost membrane of spawned eggs. This membrane was relatively thick, very adhesive, and was penetrated by a micropyle at the animal pole. It is suggested that the micropyle forms at the site of attachment in the ovary and indicates establishment of polarity in the definitive egg prior to ovulation.

(23)

Competition Between Atlantic and Pacific Pufferfishes with Possible Extirpation of Species along Some Atlantic Shorelines

ROBERT L. SHIPP, *University of South Alabama*

Based on morphological similarities to Pacific forms, the progenitor of the pufferfish *Sphoeroides testudineus* appears to have invaded Atlantic waters from the Panamanian Pacific much more recently than during the late Pliocene or early Pleistocene. This form appears to have extirpated several "more endemic" Atlantic species of the genus in certain tropical Atlantic areas, but appears to have been discretely halted in its spread into other areas by Atlantic forms.

(242)

Meiotic Prophase in *Lilium longiflorum* 'Croft' as Seen in the Scanning Electron Microscope (Angiospermae, Monocotyledonae, Liliales, Liliaceae)

J. KENNETH SHULL, JR., *Florida State University*

For the first time the scanning electron microscope has been used to (a) observe chromosomes while they are still inside the nucleus and (b) observe prophase I meiotic chromosomes. Anthers of *Lilium longiflorum* were fixed with fixatives of low pH, embedded in paraffin and sectioned at a thickness of 20μ. The paraffin was removed with xylene, the tissues were coated with a gold palladium alloy and observed in the scanning electron microscope.

Several features were clearly seen that are not visible in the light microscope. Chromosomes were associated with the nuclear boundary in all stages observed and in pachytene chromatids could be resolved in paired homologues. Sectioned nucleoli were seen to be solid structures at leptotene. At zygotene chromosomes were associated with the nuclear boundary and chromosomes were attached to them. At pachytene the nucleoli had a solid outer region with a fibrous structure in the center.

(202)

Precautions in Using Population Structure of Freshwater Mussels as an Indicator of River Pollution (Pelecypoda: Schizodonta: Unionidae)

JAMES B. SICKEL, *Emory University*

Knowledge of population and community structure of the freshwater mussels of a river system can be an important tool for assessing river conditions. Nine species of Unionids were identified from the Altamaha River in southeast Georgia in 1968-69. Percent composition of each species in different habitat types was determined and this related to sediment size. *Lampsilis dolabraeformis* and *Elliptio spinosa* were found predominantly in coarse to medium sand (0.25-1.00 mm) while *L. splendida*, *E. hopetonensis*, *E. dariensis*, *Anodonta gibbosa*, *A. couperiana*, and *Alasmidonta arcata* were predominantly in fine sand to silt (0.004-0.125 mm). *E. shepardianus* was rare but occurred in both coarse sand and silt.

Lampsilis dolabraeformis is the most abundant mussel in the Altamaha, and its wide distribution may make it an important indicator organism. Its population structure was determined as a size frequency distribution and shown to vary among different habitats, with larger individuals occurring in finer sediment. This variation must be considered when using population structure as an indicator of river conditions. The assumption is that size distribution within a population will shift toward larger individuals as pollution reaches a detrimental level and reproduction is inhibited. (Supported by NIH Traineeship, PHS Grant # ES 00108-513235)

(194)

Dynamics of Nitrogen and Phosphorus Inputs in a Bayou Estuary

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An extensive investigation of the sources of nitrogen and phosphorus in Bayou Texar, Pensacola, Escambia County, Florida has been under way since June, 1971. Surface and bottom samples have been collected from seven sites on the bayou. The forms of nitrogen and phosphorus under study have included: nitrate, nitrite, ammonia, organic nitrogen, phosphate and organic phosphorus. Spatial and temporal variation of these chemical species are being studied as well as variation between surface and bottom nutrient concentrations. To date, results indicate that Carpenter's Creek, which enters the bayou at its north end, is, with the exception of nitrites, a large source of all nitrogen forms mentioned above. The creek phosphorus levels, however, are much lower. Preliminary investigations into the role of sediments seem to indicate an exchange of sediment phosphate with bayou water as the phosphates in the water column are utilized by the plankton populations. A study of rain and runoff water, also just undertaken, indicates this may be a significant form of nitrogen and phosphorus input into the system.

(252)

Evaluation of a Protozoan, *Metacinetia micraster* (Ciliata, Suctorina) as a Model for Cellular Senescence

THOMAS E. SIMPSON, Wake Forest University

The protozoan, *Metacinetia micraster*, was investigated by electron microscopy for its potential as a model system for studying specific processes in senescence. The complexity of metazoan systems has made them generally less useful in investigating aging since intracellular changes cannot be separated from extra-cellular influence. Senescence in a unicell illustrates independence of such factors. Regulation of the rate of feeding and reproduction in this suctorian are shown to affect directly the rate and degree of senescence changes. The electron microscopical investigation of the aging *Metacinetia* suggests deleterious changes in macronuclei and nucleoli, accumulation of fibrous material externally around the cell, increase in number of intracellular microtubules, and a deterioration of mitochondrial cristae. The senescence parameters observed suggest that feeding serves as a mechanism whereby the cell's homeostatic processes are stressed and finally are unable to reverse deteriorative changes occurring in the cytoplasm.

(291)

A Morphological and Anatomical Study of Leaf Development in *Doxantha Unguis-Cati* (Dicotyledonae, Polemoniales, Bignoniaceae)

DAN R. SISTRUNK, Louisiana State University

Two distinct growth forms have been found in *Doxantha unguis-cati*, a cultivated woody vine. The juvenile form produces a pair of simple leaves at each node in a decussate arrangement, or 1/2 phyllotaxy. The adult form produces a pair of compound leaves at each node and appears to exhibit bilateral symmetry with a 1/1 phyllotaxy, due to twisting of the stem at alternate internodes. The compound leaf of the adult form is composed of 2-foliolate leaflets and a terminal tripartite claw-like thorn-tendrill. Shoot apices of the two growth forms vary significantly in shape and size. The first bifurcation of compound leaves, resulting in initiation of leaflets, occurs when leaf primordia are approximately 40 micra in height. The second bifurcation, resulting in initiation of thorn-tendrills, occurs when leaf primordia are approximately 175 micra in height. The origin and differentiation of the tissues comprising leaflets and thorn-tendrills will be briefly discussed.

(208)

Bioenergetics of the Darter *Etheostoma spectabile* (Agassiz) in a Small Kentucky Stream

JAMES W. SMALL, JR., University of Kentucky, Lexington

Caloric intake, growth, and production were studied in *Etheostoma spectabile* (Agassiz) in a small Kentucky stream. Population estimates were made five times during a fifteen month period, using a combination of the Petersen index and the two catch method. Length measurements were also taken for estimation of growth. Intake was estimated from laboratory studies on the growth-intake relationship. Caloric information was determined from oxygen bomb calorimetry and calculations were made by computer. Mean life expectancy was found to be two years, females spawning in both their first and second year. The majority of the intake calories go into respiration, production making up only about 0.03% of the total. Growth rate varies with temperature and season but is considered slow. It was suggested that slow growth allows a larger biocontent to exist under small stream conditions by allowing aquatic secondary production to meet the energy demand by quick turnover.

(292)

Comparison of Sizes of Megagametophyte Stages Among Five Species of *Cornus* L. (Angiospermae: Umbellales: Cornaceae)

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The application of a new clearing technique to whole and dissected ovules is less time consuming than traditional paraffin section techniques and facilitates studies of ontogenetic events. Data on the size of megagametophytes were obtained from cleared ovules and interpretations were made regarding the length and width and their intercept values for each megagametophyte stage of five species of *Cornus*. Comparisons of means,

confidence intervals, and growth increments were made of megagametophyte sizes of each stage among all five species. *C. asperifolia* has the largest mean length and width for every stage except for the 8-nucleate stage in which *C. stricta* had the greatest mean length. *C. stricta* does not have the smallest functional megaspore, but it does have the smallest 2-nucleate megagametophyte before becoming the largest 8-nucleate megagametophyte. The mean lengths for *C. anomum* and *C. florida* are near that of *C. asperifolia* but neither exceed the mean for *C. asperifolia*. The mean lengths and widths for *C. alternifolia* compare closely with those for *C. stricta* for all stages of development except for the abrupt increase for *C. stricta* from the 4- to 8-nucleate stage for length. Interspecies differences in width were less evident than those for length for all stages compared. However, except for a decrease in mean between *C. asperifolia* and *C. anomum* in the 4-nucleate stage for length intercept, lengths and width intercepts had similar developmental patterns as did length and width.

(174)

Low Temperature Alteration of Isocitratase Levels and Sedimentation Characteristics of Organelles from Germinating Cotton Seedlings

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Organelles from germinating cotton seeds (*Gossypium hirsutum* L. var. Carolina Queen) were isolated and separated by means of sucrose density gradient centrifugation. Mitochondrial and glyoxysomal bands were identified by assaying for fumerase or isocitrate dehydrogenase and isocitratase or malate synthetase, respectively. Treatment of intact seedlings with low temperature (5°C. for 6 or 12 hours) before isolation of the organelles sharply reduced subsequent isocitratase levels in the glyoxysomes. With progressive seedling age, mitochondrial and glyoxysomal bands exhibited altered sedimentation characteristics. These changes appeared to be reversed or inhibited when seedlings were exposed to the low temperature treatment.

(15)

Methods of Measuring Energy Flow in Reptile and Amphibian Predators

GARY C. SMITH, *Furman University*

Comparisons of energy flow in *Elaphe guttata*, *Heterodon platyrhinos*, and *Bufo terrestris* revealed that ingestion methods ($A = I - E$) gave significantly higher results than respiration-production methods ($A = P + R$) for all species. Why did the respiration-production methods yield lower results? The greatest differences in the two methods occurred when monthly increases in production or growth were smallest. This suggests that errors in metabolic measurements accounted for most of the difference. Production measurements were based on the assumption of comparable increases in lean-dry and fat components of biomass over monthly intervals. If most of the increase in biomass was fat deposition, production values would be greater. Because of the difficulties inherent in respiration-production measurements and the constancy

of assimilation efficiencies of the study animals, the ingestion method should yield better estimates of energy flow in reptiles and amphibians.

(4)

Biochemical Definition of the *Peromyscus leucopus* — *P. gossypinus* Species Group (Chordata: Mammalia: Cricetidae)

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The species, *Peromyscus leucopus* and *P. gossypinus* have been reported to hybridize in Georgia, Alabama, Mississippi, Louisiana and Texas. Sympatric populations in Louisiana and Texas are distinct biochemically but overlap in morphometric characters. It is unlikely that introgression was occurring at the sample localities. Selection for character convergence or the occurrence of introgression in the distant past may be responsible for the difficulty in assigning individuals to the two species. Levels of genetic heterozygosity are constant in *P. gossypinus* but decline in *P. leucopus* as a function of the distance of the population from the Appalachian mountains. The populations in these mountains may be central as opposed to range front populations.

(39)

Effect of Foliar Appendages and Hormones on *Coleus blumei* Apical Meristems

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The excised shoot apical meristem, 60μ high by 110μ in breadth, i.e., the dome without subjacent stem tissue and leaf primordia of *Coleus blumei* developed into complete plants when cultured on nutrient agar containing Murashige and Skoog's inorganic salts, 3% sucrose, 0.4 mg/l thiamin · HCl, 100 mg/l myo-inositol, 0.6% Difco Bacto-agar, and 2 mg/l IAA. Although isolated fern meristems had been cultured in a simple medium into complete plants, it had not been possible previously to demonstrate more than limited development in vitro of the apical meristem of angiosperms. Exogenous IAA was the sole growth hormone required, although high concentrations inhibited leaf formation. This IAA requirement could not be replaced by L-tryptophan. Kinetin was not essential, but extremely low concentrations enhanced leaf development; excesses resulted in repression of root initiation. Gibberellin inhibited formation of both leaves and roots, and high concentrations caused development of unorganized callus only. In the absence of exogenous hormonal substances the development of complete plants occurred only when the explant included some subjacent stem tissue and few to several leaf appendages, particularly leaves which have just started enlarging.

(10)

Zooplankton Observations of Two Maryland Freshwater Ponds

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Two freshwater ponds were studied periodically from April 1970 to January 1971. Both ponds, one tem-

porary and the other permanent, are located on the western shore of upper Chesapeake Bay. The first pond became dry in mid-September and remained so until late November. Free carbon dioxide, dissolved oxygen, and hardness fluctuated irregularly throughout the study. Each pond contained a distinct assemblage of zooplankters found to be influenced by the amount of aquatic vegetation present. Zooplankton species diversity in each pond was almost equal, but the temporary pond contained greater numbers of zooplankters. A congeneric occurrence of two calanoid copepods *Diaptomus birgei* Marsh and *D. sanguineus* Forbes was found in May in temporary pond 2. Various causes and mechanisms explaining co-occurrences are reviewed. Slight size differences, partial seasonal separation, and insufficient time for competitive exclusion to operate to completion appear to best explain the co-occurrence. Two generations per year of *D. sanguineus* were found in pond 2.

(232)

Growth Characteristics of Some Acidophilic Algae

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Two Chlorophyceae algae, *Chlamydomonas* sp. and *Chlorella* sp., isolated from a strip mine lake in Tuscarawas County, Ohio, were cultured in buffered BBM and enriched strip mine lake water. *Chlorella* grew in BBM buffered to pH's of 2.8, 2.95, 3.4, 4.0, 4.8 and 6.6, exhibiting a greater growth rate at the higher pH's. *Chlamydomonas* grew only in the BBM buffered to pH's of 4.0, 4.8, and 6.6. Both *Chlorella* and *Chlamydomonas* grew in strip mine lake water enriched with a 20-20-20 fertilizer. *Chlamydomonas* grew in lake water enriched with both NO_3 and PO_4 , but not in lake water enriched with either NO_3 or PO_4 alone. *Chlorella* grew in lake water enriched with NO_3 only, PO_4 only, and both NO_3 and PO_4 . When cultured in lake water enriched with only PO_4 , *Chlorella* appeared to be inhibited by the higher concentrations of PO_4 . Both *Chlamydomonas* and *Chlorella* were cultured together in buffered BBM and lake water enriched with fertilizer. *Chlorella* grew to a greater cell density than *Chlamydomonas* at pH's of 2.8, 2.95, 3.4 and 4.0 and in the enriched lake water. *Chlamydomonas* grew to a greater cell density than *Chlorella* at a pH of 4.8.

(282)

Identification of Factors in Snail Conditioned Water Stimulatory to Miracidia of *Schistosoma mansoni*

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Snail (*Biomphalaria glabrata*) conditioned water (SCW, i.e., water in which snails have been maintained for several hours) was analyzed for common organic substances. Amounts identified were considered to be inadequate for attraction of miracidia. Carbon and hydrogen analysis of dried attractive material revealed only five and one per-cent respectively. After ashing, attractive material retained activity. Subsequent analysis of calcium and magnesium in SCW indicated uptake of calcium and slight release of magnesium by snails. Parallel experiments attempting isolation of stimulatory material indicated that magnesium stimulated miracidia. Various assays of solutions with Ca/Mg ratios approximating that in SCW indicated the ability

of these solutions to stimulate miracidia. It was concluded that alteration of the Ca/Mg ion ratio peripheral to the snail results in stimulation. This stimulation appears to be non-specific in that snails in general probably produce this effect; other factors apparently are responsible for specific host recognition.

(133)

Laboratory Spawning and Development of *Lophogobius cyprinoides* (Pallas)

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A small group of the crested goby, *Lophogobius cyprinoides* (Pallas), spawned in a 200 liter aquarium at the Rosenstiel School of Marine and Atmospheric Sciences. The general reproductive behavior of these adult gobies, including sound production, is briefly described. The eggs (1 mm) were transferred to 17, 21, and 75 liter aquaria to hatch. The rearing water was stabilized by adding marine acclimated *Chlorella* sp. The newly hatched, free-swimming larvae (1.5-2.0 mm) were raised to metamorphosis solely upon a diet of two laboratory cultured strains of the rotifer *Branchionus plicatilis*, at which time *Artemia* nauplii were gradually introduced. Serial photographs are reproduced of the stages of growth from the egg to the adult, and general development of this goby is described.

(317)

Factors Effecting Vegetational Zonation on Coastal Dunes, Georgetown Co., South Carolina

RICHARD STALTER, *St. John's University*

An experimental procedure was designed to test the tolerance of sand dune taxa to regimens of (1) salt spray, (2) salt water, (3) salt spray and salt water, and (4) a control (no treatment). Twelve sites were chosen containing healthy plants occurring in pure stands or as dominants. Thirty plants in each area were labelled according to the treatment they were to receive and were treated once each two days beginning September 4, 1970, and ending October 4, 1970. *Iva imbricata* and *Spartina patens* were unaffected by all treatment at the end of the test period. *Uniola paniculata* and *Erigeron canadensis* were unaffected by the salt spray treatment. *Uniola paniculata* declined by the third week after application of (2) salt water and (3) salt spray and salt water while all *E. canadensis* died by the end of the second week after (2) salt water and (3) salt spray and salt water treatment.

(165)

Mineral Nutrition of a Submersed Macrophyte

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Eurasian watermilfoil (*Myriophyllum spicatum* L.) is a submersed aquatic angiosperm that in recent years has interfered with optimal use of reservoirs in the Tennessee Valley because of rapid propagation and formation of dense weedbeds. Basic physical and chemical

requirements for optimal growth are being determined in an attempt to obtain clues to changes in the environment that may have caused its prolific growth.

Substrate was important for optimal growth. In experiments with 100-ml bottles, root growth increased with increasing amount of substrate up to and including 54 ml. Extremes in particle size, smaller than 200-mesh and larger than 24-mesh, reduced growth. Within the intermediate range, the mineral nutrient requirements increased with a decrease in particle size. In the field *M. spicatum* is frequently sparse or absent in rocky areas where there is little substrate of smaller particle size. Another factor of importance in both laboratory and field is the concentration of hydrogen ions. The optimum in laboratory experiments was between pH 7 and 8.

Mineral nutrients that may be of some importance in limiting growth of watermilfoil in some waters are Ca, K, Mg, Fe, and B. At levels occurring in reservoirs in the Tennessee Valley, phosphate inhibited growth of *M. spicatum* under laboratory conditions. Borate may be the most important pollutant contributing to the dramatic increases in this weed during the past 30 years.

(244)

Characterization of Spontaneous and Induced Mutations to Benomyl Resistance in *Neurospora crassa*.

CAROL J. STANTON AND JOHN R. BAYLIS, JR.
University of Florida

Strains resistant to growth inhibition by the systemic fungicide benomyl [methyl-1-(n-butyl carbonyl) 2-benzimidazole carbamate] were isolated from wild-type 74A and 74a. The growth of wild-type strains is completely inhibited in media containing 0.4 µg/ml benomyl. Strains isolated which produced measurable growth in media containing 0.5 µg/ml of benomyl were designated as benomyl resistant. Many of the benomyl resistant strains were either slightly resistant (able to grow in media containing 0.5-2 µg/ml of benomyl) or highly resistant (able to grow in media containing 25-50 µg/ml of benomyl). Some resistant strains showed an enhanced growth rate at low concentrations of benomyl. The spontaneous mutation rate to benomyl resistance is less than 10^{-7} . UV induces benomyl resistant mutations at rates several orders of magnitude higher. Crosses made to determine the number of loci involved in benomyl resistance are discussed.

(309)

A Preliminary Report on Base-Line Vegetation Studies in the Jay Oil Field

JOHN STEVENSON AND JOE EDMISTEN
University of West Florida

The Jay, Florida oil field promises to be one of the major new finds of North America. By December, 1971, Humble Oil alone had 18 active wells in the Jay area. Exploitation of this resource poses a possible threat to local plants and animals, either by leaks or by-products. H_2S is separated from the crude oil and converted to elemental sulfur at a plant near Jay, and a soon-to-be constructed pipeline to Mobile will broaden the leakage risk. This project was designed to provide base-line data for future assessment of accidental ecological damage. Data consists of aerial infrared and color photography, plus data from permanent nested quadrats for ground truth samples. These quadrats will also be photographed

from marked repeatable positions to indicate seasonal variation. Only winter data will be reported in this paper.

(131)

The Reproductive Behavior of Three Species of Darters (*Etheostoma*) of the Subgenus *Nothonotus* (Osteichthyes, Perciformes, Percidae)

ROBERT A. STILES, *University of Tennessee*

Observations on the spawning behavior of *Etheostoma maculatum vulneratum* (Cope), *E. rufilecatum*, and *E. cananum* (Cope) were carried out by the author during the years 1969-1971 in Tennessee's Little River as part of a larger study of their comparative ecology. It was found that *E. rufilecatum* spawned by burying beside rocks in gravel as does *E. cananum* whereas *E. maculatum*, as reported by earlier workers, lays its eggs on the undersides of rocks. All three species show various degrees of territorial behavior with *E. maculatum* males exhibiting the most territoriality. All three species exhibit a rather unique appeasement behavior. *E. maculatum* begins spawning earlier than the other two species in the Little River. This may be related to differences in microhabitat. It was also noted that adverse environmental conditions such as flooding, low water, ect. may postpone or stop spawning altogether.

(205)

Effects of Dredging on Fishes and Macroinvertebrate Populations

HARVLY L. STIREWALI
Augusta College and the University of Tennessee

This is a report of a three year study on the effects of stream dredging on the macrobenthic fauna and game fishes in the French Broad River between Douglas Dam and the Seven Islands Location. Observations and collections were made on riffle areas above and below the dredging operation. Emphasis was placed on particle load, current velocity, water discharge, substrate, topography, fish stomach contents and spawning utilization. Pronounced decreases in some of the major categories of bottom fauna 0.3 of a mile below the area of dredging activity are attributed to increases in the concentration of particles in the size range of 1.0 to 2.0 mm. in diameter. The analysis of stomach contents shows a similar decrease in the same major categories as was observed in the bottom samples.

(91)

Biochemical Studies of Environmental Temperature Effects on *Micropterus salmoides*

LEWIS P. STRATTON, ANN S. PAGET
AND J. EDWARD BROWN
Furman University

LDH isozymes in tissues of Largemouth Bass (*micropterus salmoides*) have been studied using disc electrophoresis on verticle slab polyacrylamide gels. Bands 1 (most anodal), 2, 4, and 5 were observed in heart and brain homogenates while only 4 and 5 were found at significant concentrations in liver. Muscle homogenates from fish acclimated to normal water had a significantly more intense band 3 whereas bands 4 and 5 were less intense than corresponding bands in fish acclimated to

warm temperatures. Thermal stability studies showed that heart LDH was significantly more heat stable than the muscle enzyme although no difference was noted between warm acclimated and normal fish. Kinetic investigations have shown differences in apparent K_m and V_m values that appear to be significant.

(285)

Ultrastructural Studies on the Lymphatic System of *Megalodiscus temperatus* (Trematoda: Digenea)

PATRICIA A. STRONG, *Vanderbilt University*

The lymphatic channels of *Megalodiscus temperatus* were studied with the electron microscope. The channels consist of a syncytial layer of epithelium possessing lamelloid processes on the luminal surface. Electron dense granules are found in superficial vacuoles formed by these processes. The cytoplasm contains extensive smooth endoplasmic reticulum, small regions of rough endoplasmic reticulum, numerous mitochondria, and numerous lipid droplets. Vesicles containing membranous remnants are evident. Large, tightly packed clumps of microtubules are scattered throughout the cytoplasm. The lymphatic system is connected to the digestive system by large parenchymal cells. These parenchymal cells contain numerous large mitochondria, microvillar-like structures, and large quantities of glycogen. The function of the lymphatic system remains speculative at this time. The structure of the system indicates some type of energy-requiring transport function. It is possible that the system is involved, in part, with excretion of lipidic materials. The composition of the electron dense granules found in the superficial vacuoles may give some clue as to the function of the system.

(152)

Further Studies on Prediction of Stem Weight from Stem Height in *Spartina alterniflora*

LINDA M. STROUD, *North Carolina State University*

A previous study on estimation of living standing crop values was made on short, medium, and tall *Spartina alterniflora* growth forms in a low saltmarsh on Oak Island, North Carolina in 1965. A correlation coefficient of 0.94 obtained from a multiple regression program of weight on height in this study indicated that if height is known, weight can be predicted with a reasonable degree of accuracy. A second study was initiated to determine if the prediction equation, $\log_e (wt) = -4.24 + 1.61 \log_e (ht)$, obtained in the previous study would remain the same over a period of time and in various *Spartina alterniflora* saltmarshes along the North Carolina coast. Five marshes were selected for study representing all stages of marsh development—new to old—along the North Carolina coast. Clip plots of plant material were taken from May through September at monthly intervals. Height and weight measurements of all stems were taken in May. Ten stems were randomly selected from the total number of stems in each sample in June through September collections. An attempt to determine if one concentrated collection can be used to estimate living standing crop versus sampling throughout the growing season was also made in this study.

(74)

The Effect of Hardness on the Toxicity of Zinc Sulfate to the Rotifer *Philodina* sp. (Bdelloidea, Bdelloida, Philodinidae)

GAIL SULLIVAN AND ARTHUR L. BUIKEMA, JR.
Virginia Polytechnic Institute and State University

A preliminary study on the toxicity of zinc sulfate to the rotifer *Philodina* sp. indicated that in creek water with a total hardness of 280 p.p.m. the 24-hr. TL_{50} for zinc sulfate was greater than 100 p.p.m. at pH 6.9 and 23 C. In contrast, the toxicity of zinc sulfate in deionized water was considerably greater, the 24-hr. TL_{50} being less than 1 p.p.m. at pH 6.5 and 23 C. To define more precisely the relationship between hardness and zinc sulfate toxicity 24-hr. TL_{50} 's for zinc sulfate in synthetic waters ranging in total hardness from 1 to 300 p.p.m. were determined.

(196)

Effects of a Natural Draft Cooling Tower on the Local Environment

ALBERT L. TATE, *Emory University*

Large natural draft cooling towers, such as one being studied at the Bowen Steam Power Generating Plant near Cartersville, Georgia, discharge from about 8,000 to 13,000 gallons per minute of water as vapor into the atmosphere. Temperature, humidity, dew condensation, and rainfall were monitored at five stations selected for their environmental similarity and located from 0.75 to five miles away from the cooling tower. Environmental data for a 21 week period, along with plant operations records and data from proximal ESSA weather stations are evaluated with respect to effects on the local environment.

(153)

Role of Phenology to Production in Forest Understory Vegetation *

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The life-forms or phenophases during plant development begin with seed germination, progress through vegetative to reproductive cycles, and terminate in senescence and leaf-drop. Associated with the phenodynamics are changes in biomass, productivity and nutrient composition. Such quantitative analyses reflect the interactions of meteorology with primary production and mineral cycling within forest ecosystems.

Beginning in 1971 a study was initiated to determine the role of phenology in production and nutrient pools of forest understory vegetation. Preliminary results of Mayapple (*Podophyllum peltatum* L.), a conspicuous herbaceous species of eastern deciduous forests, illustrate the changes associated with seasonal phenomenon. Within the forest, mayapple communities ($n=21$) varied from 0.66 to 176.6 m², and contained from 10 to 683 plants. Plants were harvested at the onset of obvious phenophases and partitioned into leaf, stem, flower, fruit and rhizome-root components for biomass estimates.

During the period of fruit ripening, leaf and stem (petiole) accounted for 57% of total biomass, while

fruit and seeds accounted for 17%. At the same period, the perennial rhizome-root (1970 increment) represented 24% of total biomass. Following senescence of aerial parts, biomass of the rhizome-root system was equally distributed (50%) between the 1970 component and current increment (1971). Based on frequency in sample plots (70%) mayapple annual production for the forest area is 7.0 g/m² above ground and 1.5 g/m² below ground. Productivity was maximum during the onset of the reproductive phase (0.53 g/m²/day), diminishing to 0.03 g/m²/day by the end of the seasonal growth period.

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(311)

Vegetation Analysis in the Dry Tortugas *

H. J. TEAS AND P. B. SCHROEDER, *University of Miami*

During 1970 and 1971 detailed vegetation analysis of five islets of the Dry Tortugas was completed. Those keys of the group supporting vegetation, Loggerhead Key, Garden Key, Bush Key, Long Key and East Key were studied. Ground truth observations by field parties from the University of Miami, aerial photography, and I²S image enhancement equipment were used. It has proved possible to distinguish several vegetation associations and to identify a number of plant species by remote sensing. Associations of beach strand communities, specific strands of beach vegetation and mangrove species can be differentiated. Individual trees, both native and exotic, can be identified. At present, all of the keys listed above have been surveyed ecologically and mapped.

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(201)

Effects of Increased Temperature on the Survival of Zooplankton

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Experiments to determine the effects of a sudden increase in temperature on zooplankton entrained in power plant cooling systems were carried out in the laboratory. In these experiments, groups of *Artemia* nauplii, *Tigriopus californicus*, and mixed estuarine zooplankton were acclimated at 5°, 15°, and 25° C and transferred to temperatures 5°, 10°, 15°, and 20° C above acclimation temperature. After exposure to elevated temperatures for 5, 10, 30, 60, and 90 minutes, the organisms were returned to the acclimation temperature and the dead were counted after 24 hours. Survival was affected not only by shock temperature but also by acclimation temperature and length of exposure to the elevated temperature.

(177)

Thermostability of Enzymes and Total Proteins of Peanuts: *in situ* (Dormant and 5-Day) and *in vitro* (dormant): Electrophoresis

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Dormant peanut seed were wet roasted or dry roasted 110-155 C for 1 hr; extracts of dormant seed were heated 25-100 C for 15 min or 30 min; 5-day germinated seed were wet heated 25-121 C for 30 min. Starch gel electrophoresis indicated intact general proteins (primarily α -arachin) at 155 C in wet roasted seed but only weak, diffuse staining in seed dry roasted at 155 C. Malate dehydrogenase (MDH), glutamate dehydrogenase (GDH), α -esterases (α -EST), and leucine aminopeptidase (LAP) were slightly active at 130 C in dry roasted seed but weakly active or nil at 110 C in wet roasted seed. Peroxidases (pyrogallol) were present only in seed dry roasted at 110 C. Altered general proteins were present in dormant seed extracts heated to 100 C. Enzymes were inactivated *in vitro* at different temperatures; MDH at 65 C, GDH at 80-85 C, α -EST at 65 C and LAP at 70 C. General proteins were not altered but gradually disappeared in seed heated 25-100 C. Enzymes were inactivated at temperatures similar to the *in vitro* heating. Peroxidases (pyrogallol or benzidine) were inactivated near 75 C and 85 C, respectively. Selective inactivation of isoenzymes was obvious in all three studies.

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(181)

Isolation and Characterization of Protein Pigments Absorbing at Wavelengths Which Regulate Cell Division in a Photosynthesizing Organism.

Protosiphon botryoides

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JOSEPH C. O'KELLEY

University of Alabama

Synchronously dividing cultures of a photosynthesizing microorganism, *Protosiphon botryoides*, can be obtained by alternating blue light (400-490 nm) and light of longer wavelength (520-690 nm). Maximum inhibition of cell division occurs at 420 nm, while maximum stimulation of cell division occurs at 550 nm. Previously undiscovered pigments absorbing light at these wavelengths have been extracted from synchronously dividing cells. A pigment absorbing light maximally in the visible spectrum at 420 nm has been isolated and partially characterized. The pigment is proteinaceous, contains calcium as a metal component, and has a molecular weight greater than 70,000.

(299)

Floral Initiation in *Nicotiana tabacum* L. 'Coker 319' in Phytotron-Controlled Environments

JUDITH F. THOMAS, DR. C. E. ANDERSON, AND
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North Carolina State University

The vegetative apex of *Nicotiana tabacum* L. 'Coker 319' has been observed to be sensitive to temperature and photoperiod in regards to the number of leaves initiated and to the time of floral initiation. The plant is said to be day-neutral, but the present data suggests otherwise. Cool day/night temperatures produced reduced plant growth, lower total leaf number and fully developed inflorescences. In warm day/night temperatures plants were tall, produced a high total leaf number, and showed no indication of floral initiation. Varying photoperiods with and without interrupted nights produced new ranges of plant growth, total leaf number and apical development when one temperature regime was maintained. It is possible that the concept of the intermediate apex can be applied to apices which remained vegetative throughout the length of the experiment.

(268)

Observations on Reproduction in Three Sympatric Species of *Ambystoma* in Central Alabama

KELLY THOMAS AND ROBERT H. MOUNT
Auburn University

Observations on reproduction in three sympatric species of *Ambystoma*, *A. opacum*, *A. maculatum*, and *A. talpoideum*, have been made for 2 consecutive years at a breeding site in central Alabama. Seasonal and weather influences, microhabitat preference, and vertical stratification will be discussed.

(250)

A Fine-Structural Analysis of the Spermatozoa of *Stylochus zebra* (Turbellaria, Polycladida)

MARY BETH THOMAS, Wake Forest University

The general morphology and fine structure of the spermatozoon of the polyclad flatworm *Stylochus zebra* were described from light and electron microscope studies. From examination of thin sections, the main body of the spermatozoon is found to be ensheathed by a system of cortical singlet microtubules which lie just beneath the plasma membrane. Within the sheath of cortical singlets are found the nucleus, four types of membrane-bound granules, and, at the posterior end, the basal bodies of the two flagella. The flagella are of the "9 + 1" type typical of many species of platyhelminths. The flagella of the spermatozoa of *Stylochus* are directed anteriorly, attached superficially in grooves which occur along the main body of spermatozoon. Previously unreported aspects of the attachment of the flagella to the main body, and of the morphology of the organelles of the spermatozoon, were described. The relation of the findings to studies of the comparative morphology of the spermatozoa of the turbellarians was discussed.

(31)

DNA Synthesis and the Phototransformation of Etioplasts into Chloroplasts¹

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It is well known that light is necessary for the transformation of etioplasts into chloroplasts. There is also much evidence that DNA synthesis occurs in plastids. We have asked whether DNA synthesis occurs in plastids during phototransformation of etioplasts into chloroplasts. The eight-day old etiolated wheat leaf is ideally suited for answering this question. Using incorporation of labelled thymidine into the acid-insoluble fraction as an indication of DNA synthesis, we have found extensive incorporation in the basal, meristematic portion, but no incorporation in the apical portion, of the etiolated leaf. When the etiolated leaf is exposed to light, phototransformation occurs and a low level of DNA synthesis is activated in the apical portion. This finding suggests that DNA synthesis may occur in plastids during phototransformation. CsCl density gradient centrifugation can show whether the labelled thymidine is specifically incorporated into plastid DNA during the phototransformation.

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(87)

A Histological Study of the Structural Adaptation of Medullary Nephrons in *Gallus domesticus* for a Potential Counter-Current Mechanism

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University of Mississippi

Avian kidneys are divided into three lobes and within each lobe nephrons are contained in lobules. The lobules merge and form ureteral branches. There are two types of nephrons in the lobules. Those in the region where lobules merge have loops of Henle and are called medullary nephrons. The other nephrons above this region are the cortical nephrons and they lack a loop of Henle.

In mammalian kidneys the loops are known to function in a counter-current fashion to produce a concentrated urine. Such a function has been attributed to the loops of Henle in medullary nephrons of birds. This histological study on medullary nephron loops and blood vessels was done to determine whether or not these nephrons were structurally adapted for a counter-current mechanism.

(217)

Photoperiodic and Thermoperiodic Entrainment
of Daily Rhythms of Responses to Prolactin
in the Lizard, *Anolis carolinensis*
Reptilia Lacertilia

TERRY N. TROBEC AND ALBERT H. MEIER
Louisiana State University

Daily rhythms of fattening and gonadal responses to prolactin were entrained by either a daily photoperiod or a daily thermoperiod. In one experiment, the lizards were maintained on a daily photoperiod (12L:12D) and a constant temperature (30°C). In another experiment, the lizards were maintained in constant light and a daily thermoperiod of 12 hrs at 20°C and 12 hrs at 30°C. Injections of prolactin were given daily for 8 days at 0, 4, 8, 12, 16 or 20 hrs after the onset of either the light period or the cold period. Injections of prolactin given 0 or 12 hrs after the onset of cold or 16 hrs after the onset of either light or cold stimulated the weights of fat bodies. Injections of prolactin given 0 or 12 hrs after the onset of cold or 16 hrs after the onset of light inhibited testicular weights. The weights of the testes were stimulated in those groups that received injections of prolactin at 4 or 20 hrs after the onset of cold. These results suggest that a daily thermoperiod as well as a daily photoperiod may entrain daily rhythms of tissue responses to prolactin.

(305)

Establishment and Impact of Exotic Plant Species
in Joyce Kilmer Memorial Forest

LARRY W. TUCKER AND J. DAN PITILLO
Western Carolina University

Primeval areas such as the 3800-acre Joyce Kilmer Forest watershed are not closed to establishment of introduced plant species. Probably the most significant past impact of exotics on the Kilmer watershed was the effective removal of chestnut (*Castanea dentata*) by chestnut blight (*Endotheca parasitica*). It has been estimated that portions of the Kilmer watershed were 70% dominated by chestnut in the recent past. There are a few introduced woody waifs around old homesites existing for at least 30 years after abandonment. Weedy herbs are frequently encountered in disturbed areas such as trail borders and roads and may be found in disturbed soils of uprooted trees. These weeds may become a permanent feature of the Kilmer watershed. It is concluded that no major community changes due to exotic plant species will be likely unless major forest disturbances or unusually virulent diseases kill out major tree species.

(66)

The Effect of Selected Antimetabolites on
Development in *Volvox aureus* M5
(Volvocaceae)

ROBERT G. TUCKER AND W. H. DARDEN, JR.
Troy State University and The University of Alabama

Actinomycin D, mitomycin C, actidione, chloramphenicol and hydroxyurea were screened over a wide concentration range for developmental effects in *Volvox aureus* M5. The antimetabolites were shown to have various effects depending upon the stage of development

at which they were administered. The results are discussed relative to development in *Volvox*.

(296)

Wound Repair in Leaf Blades of Magnoliaceous
Plants (Angiospermae; Magnoliales)

SHIRLEY TUCKER, *Louisiana State University*

Evidence of tissue regeneration around old wounds on leaves was observed in cleared evergreen leaves of species of *Kmeria*, *Magnolia*, *Manglietia*, *Michelia*, and *Talauma*, (Magnoliaceae). As wound repair has not been described for leaves, the processes involved are of interest. First a band of cells a short distance from the cut becomes suberized, and xylem becomes occluded. Second, parenchyma dedifferentiates in epidermis, vein sheaths, and mesophyll; numerous cell divisions produce a callus-like proliferation of small, uniform-sized cells lacking appreciable intercellular spaces. In some species, a band of hypertrophic cells develop, elongated perpendicular to the cut edge. Guard-cells dedifferentiate and divide in some taxa. The third step is periderm formation, as cells of the callus-like zone divide periclinally to form cell files. Experimental work is proceeding to clarify the wound response in evergreen leaves. The significance of wound repair to leaf longevity is discussed.

(189)

Dissociation of *Pentachaeta* from *Chaetopappa*
(Asteraceae: Astereae)

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University of Tennessee at Chattanooga

This study considers the relationships between *Pentachaeta* and *Chaetopappa* (Asteraceae: Astereae) which have been considered congeneric by recent authors (Keck, 1958; Munz and Keck, 1959). Present evidence indicates that the genera are not closely related. *Pentachaeta* and *Chaetopappa* differ with respect to various characters such as basic chromosome number, style tip shape, crystal type, phyllary anatomy, position of first foliage leaves, type of leaf trichome, and receptacle shape and surface. Both genera are relatively heterogenous. Almost all species of *Pentachaeta* are endemic to California while the center of distribution of *Chaetopappa* is Texas.

(5)

Removal of Rodents from a Forest-Field
Ecosystem by Predators

C. KENYON WAGNER, *University of Georgia*

Between August 1, 1969 and July 31, 1970, 700 *Apodemus flavicollis*, 500 *Apodemus agrarius* and 500 *Clethrionomys glareolus* were estimated to be present in a 108 hectare forest. About 1000 *Microtus arvalis* lived in a 40 hectare band of fields surrounding this forest during the same period. The dietary make-up of foxes (*Vulpes vulpes*), martens (*Martes foina*), badgers (*Meles meles*), buzzards (*Buteo buteo*) and tawny owls (*Strix aluco*) were also studied within the same time span. These predators ate about 1,200 forest rodents and about 1,100 field voles. This data is preliminary and only indicates that a large percentage of these rodent populations are eaten by predators. The fact that

more field voles were eaten than were estimated to be present results from the underestimation of the size of the territory hunted by owls and the inaccuracy of the method used to census field rodents.

(13)

The Ecology of an Intergrade Population of *Hexagenia munda marilandica* and *H. m. elegans* (Ephemeroptera) in Stone Mountain Lake, Georgia

WILLIAM H. WALKER, JR.* AND W. D. BURBANCK
Emory University

A large population of burrowing mayflies living in Stone Mountain Lake, filled in 1964, appeared to be intergrades of the southern highland *Hexagenia munda marilandica* and the coastal plains subspecies *H. m. elegans*. Individual adult males and large nymphs with wing pads have morphological characteristics and color patterns intermediate between those of the subspecies; adults which most closely resemble each subspecies are interfertile; large *marilandica*- and *elegans*-like nymphs have the same respiration rate; and nymphs, regardless of subspecific variations, occupy the same habitat niche.

Nymphs live for one year and are nonselective detritus feeders using their enormous mandibular tusks for burrowing. They transfer energy from organic detritus to carnivores. Distribution in the lake seems to be independent of pH and temperature but low dissolved oxygen is limiting. Nymphs migrate to areas having favorable conditions. Burrows cannot be established in substrata with more than 55% sand by weight. Although nymphs are negatively phototactic and respond positively to cover, they respond more strongly to burrows and even occupy glass tubes in the light when cover is available.

* This research was supported by a Traineeship of the National Institutes of Health, Grant ES00108.

(279)

Observations on the Responses of the Instar Stages of *Callinectes sapidus* (Rathburn) to Light

JOHN W. WATSON, JR., University of West Florida

The spectral sensitivity and photic reactions of the instar stages of *Callinectes sapidus* were investigated in intensity gradients from .01 to 10,000 Lux of incandescent white light and narrow band wavelengths of 489, 546, and 656 m μ . Larvae reared in the laboratory under controlled conditions were exposed to a light gradient and their reactions recorded by photographic techniques. Zoa tested at various stages of development exhibit a positive taxis from minimum intensities toward maximum intensities in both the white spectrum gradient and at a wavelength of 489 m μ . Upon metamorphosis to the megalopa stage *C. sapidus* larvae exhibit a reverse taxis in response to the white spectrum moving from maximum intensities toward minimum intensities and a positive taxis toward maximum intensities at 489 millimicrons. No consistent reaction was observed at wavelengths of 546 or 656 m μ for either stage of development.

(302)

The Role of Annual Litterfall in Dry-Matter Dynamics of Contrasting Forest Ecosystems

GEORGE T. WEAVER, Southern Illinois University

Annual litterfall in high elevation forests of the Balsam Mountains, Western North Carolina averaged 9200 kg./ha. in spruce-fir stands, 4474 kg./ha. in immature yellow birch stands, and 5614 kg./ha. in mature yellow birch stands. These values were 5.2%, 4.4%, and 3.6% of tree-shrub biomass of coniferous and immature and mature yellow birch stands respectively. Litterfall of boles and large branches was 40% of total litterfall in spruce-fir stands and 10-17% of total litterfall in yellow birch stands but was highly variable emphasizing the necessity of sampling production of these components over long-time intervals. Leaf litterfall including reproductive components, foliage, and small twigs and bark was equivalent to 72.1% and 63.2% of above-ground annual net primary production of spruce-fir and immature yellow birch stands; foliage litterfall was equivalent to 44.8% and 53.4% of net production in these stands. Significant differences in dynamics were indicated between immature and mature yellow birch stands; in mature stands leaf litterfall and foliage litterfall were equivalent to 101.5% and 71.6%, respectively, of net primary production. These stands apparently were near maximum biomass under existing species composition and site conditions. Regression analysis indicated that annual litterfall could serve as an index of production in stands of the study area. Regression equations for estimating above-ground annual net primary production and bole net primary production of spruce-fir stands and total production, bole production and branch production in immature yellow birch stands from various litterfall components were significant at $P_{.05}$ or higher.

(235)

An Approach to the Study of the Splachnaceae

HAROLD J. WEBSTER, University of Tennessee

Laboratory culture studies of the Splachnaceae offer a methodology which will solve several of the problems of taxonomic and ecologic importance in this family. The apparent affinity of most taxa for organic substrates of animal origin has been postulated to be due to a high nitrogen requirement. Culture work might give us a better insight into their use of mineral nutrients. Documentation of phenological development, ecotypic variation, and phenotypic plasticity might offer us new data concerning the taxonomy and geographic distribution of these taxa. Also, the postulated hybrid parentage of *Tetraplodon mnioides* var. *paradoxus* (R. Brw.) C. Jens. might be clarified by crossing the proposed parents, *Tetraplodon mnioides* (Hedw.) B. S. G. and *Voitia nivalis* Horsch., and growing the progeny, all in culture.

(265)

Survival of Immature Amphibians at Various Combinations of Anoxia and Temperature

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Mississippi State University

As a possible index to ecological distribution, ontogenetic and interspecific tolerances to nitrogen anoxia

and carbon dioxide hypoxia were determined for larval anurans and caudates. Effects of increased and lowered temperature on survival under the above conditions were measured, and both short term and long term acclimation studies were conducted. These data were correlated with the known ecology of the animals, but since the apparent correlation is not always obvious, other factors are certainly important in the occupation of specific habitats by immature amphibians.

(220)

Retention of ^{14}C -aldrin and ^{14}C -Dieldrin in Cellular Fractions of Vertebrate Insecticide-Resistant and Susceptible Tissues

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Middle Tennessee State University

AND
Mississippi State University

Aldrin and dieldrin resistant and susceptible populations of mosquitofish (*Gambusia affinis*) were assayed for aldrin and dieldrin retention in particulate fractions of livers and brains following *in vivo* and *in vitro* treatment with ^{14}C -aldrin and ^{14}C -dieldrin. The *in vivo* studies indicate a highly significant difference in retention between all particulate fractions of susceptible and resistant fish brains and points to a membrane barrier to aldrin and dieldrin in resistant tissues.

(257)

Analysis of Cohabitation by *Gambusia affinis* and *Poecilia latipinna* (Pisces: Poeciliidae) in a Salt-Marsh Canal in Florida

RICHARD L. WETZEL AND JOHN P. KERR
University of West Florida

Gambusia affinis and *Poecilia latipinna* are positively associated throughout the majority of their natural ranges and form a quite common association of fish species. The objective of the research was to determine those characteristics of the two populations which allowed for compatible coexistence. Sampling data was gathered by trapping in a salt-marsh canal in northwestern Florida between June 1970 and August 1971. Food content analyses of the digestive tract of adult *G. affinis* and *P. latipinna* revealed that the two fish species differ in their food preference. In the canal, *G. affinis* utilized 11 of 13 food categories established for the habitat. *P. latipinna* utilized only three. *G. affinis* is classed as an omnivore while *P. latipinna* is a restricted herbivore. Trapping along the long axis of the canal indicated that both populations cohabitated the same area. Two diel studies indicated that within a given portion of the canal the two populations had dissimilar activity patterns. Sampling data revealed that the activity of both populations was reduced during the day-light hours. *G. affinis* was active at or around the time of sunset and maintained an increased activity state throughout the night. *P. latipinna* displayed a well-marked activity peak at sunset which progressively decreased to the time of moonset or total darkness.

(55)

The Enzymatic Isotope Effect Associated With PEP Carboxylase

TOM WHELAN¹ AND W. M. SACKETT
Department of Oceanography
Texas A&M University
College Station, Texas 77843

AND
C. R. BENEDICT
Department of Plant Sciences
Texas A&M University
College Station, Texas 77843

It has been previously shown that the cellular constituents of a C_4 plant are enriched in ^{13}C with respect to those in a C_3 plant. The isotope fractionation associated with the enzymatic synthesis of OAA was studied to determine if the relative isotope composition of the cellular constituents in a C_4 plant was established at the CO_2 fixation step. The cell free synthesis of malic acid from PEP and CO_2 , from a crude extract of PEP carboxylase in sorghum, resulted in 3 ± 4 o/oo enrichment of ^{13}C into malic acid. The cell free synthesis of PGA from a crude extract of RuDP carboxylase in sorghum resulted in a 42.9 ± 6 o/oo enrichment of ^{13}C into PGA. This is a 25 o/oo larger isotope effect than has been previously reported for the enzymatic synthesis of PGA. The isotope data from the cell free reactions indicate that the isotope composition of the cellular constituents is dependent upon CO_2 fixation mechanism.

¹ Present address: Coastal Studies Institute, Louisiana State University, Baton Rouge, Louisiana 70803

(56)

Carbon Isotope Fractionation in Chromatium

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Carbon isotope ratios were determined in several metabolic intermediates of the photosynthetic bacterium Chromatium strain D. When Chromatium was grown with bicarbonate as the carbon source, the cellular constituents were isotopically similar to those in cotton (-20 to -27 o/oo). When Chromatium was grown with acetate as the carbon source, a different suite of carbon isotope ratios resulted. The sugars were enriched by 18.9 o/oo in ^{13}C with respect to the acetate. The lipid fraction, however, was enriched by only 7.7 o/oo in ^{13}C with respect to the acetate. The sugars produced from fat in the dark germinating castor bean demonstrated a similar trend. They were 5.5 o/oo enriched in ^{13}C with respect to the photosynthetically produced sugar stored in the ungerminated seed. The primary isotope effect in sugar produced from malic acid in acetate grown Chromatium presumably occurs at the PEP carboxykinase step.

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(7)

Relative Efficiency of Four Small Mammal Traps

JAMES G. WIENER
Savannah River Ecology Laboratory

Relative efficiencies of 4 types of traps were determined. Traps were arranged on either a grid and assessment lines or on lines. 1329 small mammals, mostly cricetids and heteromyids, were captured. The Museum Special snap trap was significantly more efficient than the Sherman live trap, the Victor-rat snap trap and the Victor-mouse snap trap for capturing both types of rodents.

(127)

A New Cottid Fish from the Tallapoosa River
With a Review of the *Cottus carolinae* Species
Group in the Mobile BasinJAMES D. WILLIAMS, *Mississippi State College for Women*

A new species of *Cottus*, the Tallapoosa sculpin, is described from the drainage area above the Fall Line in the Tallapoosa River system in Alabama and Georgia. The new species is most closely related to *Cottus carolinae zopherus* which is present throughout the Coosa River, the upper Cahaba, and the eastern Warrior drainage. The new species differs most in having eight infra-orbital canal pores; uniform chin pigmentation; incomplete lateral line; and narrow dorsal saddles. Three of the five species and subspecies of *Cottus* in the Mobile Basin belong to the *C. carolinae* species group. The zoogeography, speciation, and habitat notes of the *C. carolinae* species group in Mobile Basin is discussed.

(277)

A Preliminary Report on the Naiad Mollusks
(Bivalvia: Naiadoida) of the Tombigbee River
in the Vicinity of Columbus, MississippiJAMES D. WILLIAMS
Mississippi State College for Women
ANDDAVID H. STANSBERRY
The Ohio State University Museum of Zoology

A survey of the naiad fauna of the Tombigbee River within 15 miles of Columbus, Mississippi, was conducted during the Fall of 1971. The study is based on 15 collections taken from the Tombigbee River proper. To date (January 1972) 33 species have been identified. The present day fauna and habitat are compared with that reported by Hinckley in 1906 (Naut. 20:52-55) (39 species) and by Van der Schalie in 1939 (Occ. Pap. Univ. Mich. Mus. Zool. No. 407:1-6) (37 species).

(72)

Cycling of Mercury and Other Heavy Metals
in the Black Warrior RiverLOUIS G. WILLIAMS, *University of Alabama*

The increase of depth during pool stage from navigation dams results in deterioration of water quality with the increased amounts of organic matter containing high concentrations of mercury, cadmium, and other heavy metals which accumulate as ooze in deep pockets

along the bottom. Fish-killing slugs and destruction of beneficial plankton communities occurs only after heavy rains bring increased stream velocity creating turbidity from bottom ooze, which is scuffed up to produce moving toxic slugs of contamination, mostly of industrial origin.

(48)

Stomatal Movements and Associated Potassium
Fluxes in the Plant Kingdom¹C. M. WILLMER AND J. E. PALLAS, JR.²

Plants were obtained with their stomata either open or closed. Histochemical tests for K⁺ were conducted on epidermal strips or paradermal sections from these plants.

So far the stomata of the more primitive plants (*Psilotum nudum*, a *Selaginella* species and *Equisetum nimale*) and those on the corolla of *Bryophyllum calycinum* Salisb. and some Compositae and Lilaceae species have shown reluctance to open. Hence, K⁺ tests were inconclusive.

At and above the evolutionary level of the ferns, substantial stomatal opening was obtained. Species studied were *Polypodium aureum* L. (a fern); *Zea mays* L., *Hordeum vulgare* L. (monocots possessing graminaceous-type stomata); *Allium cepa* L., *Commelina communis* L. (monocots); *Vicia faba* L., *Pelargonium zonale* L., *Senecio odoris* Desf., *Arachis hypogaeae* L. (dicots); and, *Kalanchoë daigremontianum* Hamet and Perrier (a succulent dicot). In all of the species tested, the guard cells accumulated K⁺ when the stomata opened whereas little K⁺ was observed in epidermal or subsidiary cells. The guard cells of stomata on the sepals of *P. zonale* also accumulated K⁺ upon stomatal opening.

When stomata closed, only negligible amounts of K⁺ could be occasionally detected in the guard cells of the species studied. However, it could be detected in the epidermal cells immediately surrounding the guard cells of *P. aureum* and occasionally in the subsidiary cells of *H. vulgare* and *Z. mays*. Other epidermal cells in these species did not indicate the presence of K⁺. In all the other species, K⁺ could not be detected in subsidiary or other epidermal cells. Errors in K⁺ localization due to cell damage were considered.

It is concluded that K⁺-stimulated stomatal opening may be a common feature throughout the Plant Kingdom although different combinations of cells may participate in the mechanism depending on the species.

¹ Contribution from the Southern Branch, Soil and Water Conservation Research Division, Agricultural Research Service, USDA, in cooperation with the University of Georgia Agricultural Experiment Stations. For presentation at Southern Section of the American Society of Plant Physiology, Mobile, Alabama, April 6-8, 1972.

² Plant Physiologist, Department of Horticulture, University of Georgia, Athens, Georgia 30601, and Plant Physiologist, USDA, Watkinsville, Georgia 30677.

(206)

An Example of the Use of Preconstruction
Ecological Surveys in Regional PlanningJAMES H. WILSON, ALBERT C. HENDRICKS,
KENNETH L. DICKSON AND JOHN CAIRNS, JR.
Virginia Polytechnic Institute and State University

In a cooperative effort between the Biology Department, V.P.I.&S.U. and the New River Planning District,

aquatic ecological surveys are being conducted at four sites on the New River and one site on the Roanoke River in Virginia. Fourteen physical-chemical parameters are being analyzed along with the collection of biological information to determine the physical chemical and biological water quality of these potential industrial sites. A one year data base is being generated from which information relating to the suitability of the sites under a variety of possible industrial uses will be predicted. Such a survey has value for several reasons. It (1) provides a baseline of information to compare to later postconstruction information, (2) aids in pollution assessment, (3) predicts environmental impact, and (4) aids regional planners in industrial zoning. This work is supported in part by an Environmental Protection Agency Training Grant WP-166.

(247)

Natural Hybridization Between Two "Genetically Isolated" Species of *Hibiscus* (Malvaceae)

DWAYNE A. WISE, *Florida State University*

Hibiscus coccineus Walt. and *H. grandiflorus* Michx. are easily distinguishable natives of the Southeastern United States. *H. grandiflorus* occurs scattered in low, wet habitats in Florida and extreme southern Alabama. *H. coccineus* grows mainly along the St. John's River drainage in northeastern Florida with a few additional, scattered sites. Both have chromosome numbers of $n = 19$. F_1 hybrids between these two species showed developmental lethality. Affected plants characteristically showed epinastic foliage and stunted growth. Most died shortly after being transplanted to the experimental garden. However, one plant survived and set open-pollinated seeds the second year. A progeny from open-pollinated seed segregated for the lethal factor. Four mixed wild populations of these two species were discovered and sterile plants resembling the artificial hybrid were growing in one of them. Evidently the developmental lethal factor seen in the experimental hybrids is absent in these populations or is not selectively deleterious.

(92)

Preinduction Activity of the Inducible Malic Enzyme of *Streptococcus faecalis*

JOSEPH F. WITZEL, JR., *Georgia Institute of Technology*

HONG S. MIN, *Georgia Institute of Technology*

Folic acid deficient *Streptococcus faecalis* ATCC 8043 exhibited greater activity of the inducible malic enzyme than did cells grown in nutritionally complete media when the cells were not induced to form more than marginal quantities of this enzyme. For 30 minutes of CO_2 evolution, measured manometrically with a Warburg respirometer, little difference was observed in deficient and complete cells. Above this time period a significant increase in rate of CO_2 evolution was obtained in deficient cells, suggesting greater malic enzyme activity, while complete cells evolved CO_2 at approximately the same rate.

(41)

Auxin Transport in *Selaginella willdenovii*

ZACHARY S. WOCHOK, *University of Alabama*

Selaginella willdenovii Baker is a prostrate vascular cryptogam with a dorsiventral stem. At each major

branching of the stem apex a dorsal and a ventral angle meristem is formed. The ventral meristem becomes determined as a root, and the dorsal meristem as a shoot. The present investigation examined the distribution and transport of ^{14}C -IAA through stem tissues as a basis for the pattern of meristem determination. Externally applied IAA is transported into receiver blocks with a velocity of 12 mm/hr. The polar ratio of auxin transport is approximately two. Auxin transport is three times greater in vascular tissue than in the cortex. In the branch junctions twice as much auxin is transported on the dorsal side as on the ventral side, and this is held to be the consequence of the lateral branch vascular tissue connecting with the dorsal and median, not with the ventral vascular strand, of the stem axis.

(237)

Heterotrophic Growth in the Blue-Green Algal Genus *Nostoc*

J. T. WYATT AND J. S. HENDERSON
East Tennessee State University

Within the very similar genera, *Anabaena* and *Nostoc*, the ability to survive and grow in darkness at the expense of organic substrates is almost an exclusive *Nostoc* property. None of our experimental laboratory strains of *Anabaena* (about 30) are able to grow in .01 M sucrose while nearly all species regarded as *Nostoc* exhibit at least some growth under the same conditions. However, at realistic environmental temperatures (24°C and less), most growth rates are too low for accurate measurement. Rather than show an enhancement effect over that of nitrate, the presence of ammonium ion in the medium seems to dampen dark-growth. Those strains which develop comparatively good heterotrophic growth rates apparently are able to fix nitrogen efficiently via sucrose generated ATP since N_2 promotes growth as effectively as combined-nitrogen. Species with minimal dark-growth capacity are very erratic and often die in darkness — thus multiple test series with differently derived inocula are necessary for accurate analysis. Two of our most actively heterotrophic forms, *N. sphaericum* and *N. piscinale*, grow at measurable and substantial rates. However, these rates are far less than their phototrophic ones; therefore, heterotrophic growth in *Nostoc* may be most ecologically important as a survival mechanism.

(320)

Houstonia montana, a Species Not an Ecological Variety

JAMES D. YELTON, *East Tennessee State University*

Houstonia montana (Chickering) Small (1933), a member of Rubiaceae, appears to be morphological and genetically distinct from *H. purpurea* (L.). Ferrell (1959) treated this entity as *Houstonia purpurea*, var. *montana*. Radford, Ahles and Bell (1968) regard *H. purpurea* to be a complex species of which *H. montana* was included as a synonym. Populations of *H. montana* have been reported from Grandfather Mountain and Roan Mountain, North Carolina, but was found only on Roan Mountain by the author. *Houstonia montana* was collected from this population while *H. purpurea* was collected from populations on Roan and Bald Mountains, North Carolina. Statistically significant morphological differences were observed between the populations of *H. montana* and *H. purpurea*. Experimental crosses

between *H. montana* and *H. purpurea* suggest that a definite breeding barrier exists between these taxa. Thus *H. montana* should be considered a distinct species, not an ecological variety or morphological variation of *H. purpurea*.

(33)

Photomorphogenesis of the Dentaria Petiolar Hook

J. H. YOPP
Botany Department
Southern Illinois University
Carbondale, Illinois 62901

The phenomenon of the etiolated hook is not restricted to the hypocotyl of the dicotyledenous plant (e.g. *Phaseolus*) but appears to serve a similar, adaptive function

in the petioles of certain rhizomatous plants. The commonly employed regulants of hypocotyl hook opening were tested for their effect on the petiolar hook of *Dentaria diphylla*. The hook was found to require both light (red light promoted, far-red inhibited) and the intact leaf for opening. The leaf requirement was fully replaced by GA₃ (0.04% in lanolin) but only in light; CoCl₂ (10^{-4} - 10^{-3} M) promoted a partial opening in dark with or without leaf; and coumarin (0.001 M), IAA (1-4% in lanolin) and ethylene (1 ppm) all inhibited opening of hooks with or without leaf while drastically reducing anthocyanin synthesis. The absolute requirement for light and leaf tissue and the replacement of proximal tissue by GA₃ alone represent marked differences in the physiology of hypocotyl and petiolar hooks. These differences are believed to indicate the necessity for concomitant leaf maturation in petiolar hook opening.

approved by the Executive Committee, these will need to be confirmed by the membership at our April meeting. We have these firm invitations for future meetings: LSU, New Orleans, 1976; University of North Carolina, Chapel Hill, 1977; University of Alabama, 1978. There have been other tentative invitations, but none beyond 1975 has been approved. The Chairman of the Place of Meeting Committee, Dr. Dolores Dundee, has these invitations and welcomes additional ones for consideration by this committee.

At Mobile, we expect the Past Presidents' Group to have a breakfast meeting to consider the goals and purposes of ASB for the coming years. Additionally, I would point out the recent article in the Bulletin that Dr. Madeline Burbank has written on emeritous membership.

We wish to congratulate Dr. John Withers upon his appointment to a new office with The Office of Biological Education. He will be administering the visiting speaker program and other aspects dealing with biological education. We also are aware of the recent illness of Dr. Withers and wish him a speedy recovery.

I am in touch with a Mid-west group that is concerned with forming an organization similar to ASB, for midwestern biologists. They are impressed by ASB and requested information about our constitution, by-laws, etc.

The Research Awards Committee has a difficult job in selecting the winning papers each year, and there have been some recent changes. The Carolina Biological Supply Company has sponsored this prize for many years. Dr. Ray

Flagg and Mr. Hart are working with CBS on a special medallion for presentation to the winner from the company; ASB will probably provide the monetary award. We are grateful to Carolina Biological Supply for their continued sponsorship and support.

Drs. Burbank and Withers have been appointed to study and consider the possibility of naming a distinguished biologist for the southeastern states.

The southeastern sections of the Plant Physiologists, Ichthyologists, Herpetologists, and Parasitologists are all meeting with ASB at our Mobile meeting. Therefore, we anticipate a large turnout even though Mobile is not centrally located for some of our members.

Two items needing further attention include the prospectus of Dr. John Withers for an NSF grant to ASB in the area of biological education. This prospectus may become a formal proposal to NSF in the near future. The voting procedures at our annual meeting need study, and some changes could and probably should be made. Dr. Perry Holt was asked to study this, and he has suggested that we incorporate some changes at our next meeting.

The Executive Committee received with deepest regret the resignation of our Bulletin Editor, Mr. C. W. Hart, Jr. He was unanimously voted a commendation and expression of gratitude from the Executive Committee. In seeking a new Editor, a committee, consisting of Drs. Shanor, Gilbert and Mr. Hart considered candi-

dates for the editorship. We are happy to report that Dr. Margaret Menzell of Florida State University has accepted this position, effective with the July issue.

Our treasurer informs us that we have expended about \$2,000 more than we have received during the past year. Some of the reasons for this have been mentioned above, *i.e.*, ASB support of some of our awards which in the past have been supported by others. There are additional expenditures that will be explained at the annual meeting by the treasurer. We should seriously consider, in the very near future, a slight increase in our annual dues. In recent years, ASB dues have remained at \$4.00 while nearly all other professional society dues have been increased. I sincerely believe that our dues, at \$4.00, is one of the best bargains anywhere!

The time is approaching, also, when I believe we should give serious consideration to the posi-

tion of an Executive Secretary. The office of President is a one-year term and it is just now, as I am about ready to leave office, that I am becoming familiar with some of the procedures and duties. Our Association needs more attention, and the President can hardly identify his goals and implement them in one year. I am therefore recommending, as I leave office, that ASB give serious thought to the position of an Executive Secretary for a three-year term, and that we also have a Corresponding Secretary. Will you think about this and give your suggestions to the Executive Committee. Other items will be presented to the membership in April.

Please try to be at Mobile. All factors point to an excellent meeting. ASB is one of the soundest and most enjoyable scientific organizations of which I have ever been a part. See you in April.

University of Virginia Announces Mountain Lake Courses

The University of Virginia announces that eight graduate courses emphasizing environmental biology will be offered at the Mountain Lake Biological Station this summer. They are as follows:

FIRST TERM: June 14 — July 18

Aquatic Ecology: Dr. George M. Simmons, Jr.,
Virginia Polytechnic Institute

Algology: Dr. Francis R. Trainor
University of Connecticut

Herpetology: Dr. H. G. M. Jopson
Bridgewater College

Invertebrate Zoology: Dr. Fred Diehl
University of Virginia

SECOND TERM: July 19 — August 22

Ecological Genetics: Dr. David West
Virginia Polytechnic Institute

Pteridology: Dr. Warren H. Wagner
University of Michigan

Taxonomy of Seed Plants: Dr. Carl S. Keener
Pennsylvania State University
Mammalogy: Dr. Charles O. Handley
United States National Museum

The Ivey F. Lewis Fellowship, an annual award of \$150, is made by the Phipps and Bird Company of Richmond to a student undertaking research or graduate training at the Station. Fellowships of \$150 for one student in each term have been made available by the North Carolina Botanical Garden. This fellowship may not be held concurrently with any other stipend from the Station. The recipients of these awards are chosen by the Research and Awards Committee of the Department of Biology. Application for awards should be sent to the Director, Mountain Lake Biological Station, University of Virginia, Gilmer Hall, Charlottesville, Virginia 22903.

Wildflower Pilgrimage to be Held 4 - 6 May

The 22nd Annual Spring Wildflower Pilgrimage will be held in Gatlinburg, Tennessee and surrounding territory May 4, 5, 6, 1972. It is sponsored by the Botany Department of The University of Tennessee, The Great Smoky Mountains National Park, and The Gatlinburg Garden Club. Motorcades and trail hikes under expert leadership take you to areas where spring wildflowers grow in quantity and variety. Early morning bird walks are a feature of each day's activities, as are birding hikes. Special programs are arranged for photographers, including a photography clinic, and there is an opportunity to show one's own slides.

Each evening there are illustrated lectures on features of the natural history of the Appalachians and a plant identification clinic. Detailed descriptions of each Pilgrimage activity are furnished at the time of registration, and programs are available upon request.

For further information, write Dept. W. P., Gatlinburg Chamber of Commerce, Box 527, Gatlinburg, Tennessee 37738, or Dr. Edward E. C. Clebsch, Graduate Program in Ecology, 408 10th Street, The University of Tennessee, Knoxville, Tennessee 37916.

West Virginia University Announces Biological Station Program

The Terra Alta Biological Station announces a new design and early opening for 1972. Both 4½ week sessions will take advantage of the seasonal timing of the biota under study; and will make maximum utilization of the unique locale in the Appalachians of Northern West Virginia. Herpetofauna of the Central Appalachians, Ornithology and Taxonomy of the Vascular Plants will be offered from May 15 through June 9; Geobotany of the Allegheny Mountains, Field Studies of Invertebrates, and Seminar in Ecology from June 12 through July 12. Variable credit courses (independent study of problems) may be combined with the others in either session when registering for 6 hours of college or graduate credit. Inquiry should be directed to: Professor R. L. Birch, Director — TABS, Department of Biology, West Virginia University, Morgantown, West Virginia 26056.

TREASURER'S REPORT
ASSOCIATION OF SOUTHEASTERN BIOLOGISTS
January 1, 1971 – December 31, 1971

I SAVINGS ACCOUNTS

A. Regular Savings Accounts	\$4,151.22	
Interest added	237.21	
Deposit	740.96	
Total Regular Savings Accounts		\$ 5,129.39
B. Contingence Savings Account	\$2,402.26	
Interest added	76.85	
Balance		\$2,479.11
Transferred to Checking Account		-2,200.00
Total Contingence Savings		\$ 279.11
Total Savings		\$5,408.50

II CHECKING ACCOUNT

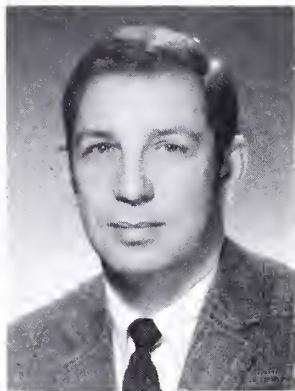
Balance on hand — 1 January 71		\$1,147.94
Transferred from Contingence Savings		2,200.00
A. Receipts		
Dues and Subscriptions	\$4,648.60	
Reprints	382.00	
Annual Meeting (Richmond)	2,057.79	
For ASB Research Award	100.00	
Total Receipts		7,188.39
Balance plus Savings Transfer and Receipts		\$10,536.33
B. Expenditures		
To Regular Savings Account		\$ 740.96
President		
Hart (travel to Richmond)	\$ 30.50	
Miller (travel to Atlanta)	\$ 70.00	100.50
Vice President		
Cotter (travel to Atlanta)	\$ 34.45	34.45
Secretary		
Gilbert (travel to Richmond)	\$ 136.00	
Gilbert (travel to Atlanta)	100.20	236.20
Treasurer		
Flagg (travel to Atlanta)	\$ 64.00	
Postage	86.14	
Supplies and Dues Notices	109.45	
Bank Charges	1.38	
CPA Audit (Cotter's Records)	230.00	490.97
Executive Committee		
Meeting (Atlanta, 16 October 71)	\$ 48.87	
Dent (travel to Atlanta)	150.00	
Fitzpatrick (travel to Atlanta)	106.51	305.38
Editor		
Hart (travel to Atlanta)	\$ 126.98	
Circulation	350.00	476.98
Bulletin		
Vol. 17 (4)	\$ 413.12	
Vol. 18 (1)	233.32	
Vol. 18 (2)	2,412.48	
Vol. 18 (3)	1,777.28	
Reprints	804.80	
Production and Mailing	1,669.99	7,310.99
Awards		
ASB Research Award	\$ 100.00	
Outstanding Teacher Award	100.00	
Goethe Awards	451.00	651.00
AIBS Affiliate Dues	\$ 50.00	50.00
Total Expenditures		\$10,397.43
BALANCE ON HAND — 31 December 71		\$ 138.90

Respectfully submitted
R. O. FLAGG, *Treasurer*

ASB Candidates For Offices - 1972

The following are brief biographical sketches of the candidates for ASB offices. Voting will take place during the business meeting at noon on Friday, 7 April.

Burton J. Bogitsh
(President)



David J. Cotter
(President)



Dr. Bogitsh, Professor, Department of Biology, Vanderbilt University received his Ph. D. degree from the University of Virginia in 1957. Upon graduation and until 1963, he was a member of the faculty of Georgia Southern College. After one year as a member of the staff of the National Science Foundation in Washington, D. C., he joined the faculty of Vanderbilt University. He has been associated with the Association of South-eastern Biologists for 18 years having served as a member of the Executive Committee for three years and on the Research Awards Committee for three years. He is Past President of the South-eastern Society of Parasitologists. Currently, he is on the editorial board of three journals and director of the NSF supported Short Course in Histochemistry for College Teachers.

His research, which has been supported by NIH and NSF, involves the ultrastructural localization of enzymes in parasitic helminths. He has published some 50 articles in this and related fields. He is co-author, with Dr. David A. Nunnally, of an introductory textbook in zoology scheduled for 1973 publication by Wiley and Sons, Inc.

David J. Cotter was born on July 24, 1932, in Glens Falls, New York. He received a B. S. degree in 1952, A. B. degree in 1953 and M. S. degree in 1955 from the University of Alabama. He received his Ph. D. degree in ecology at Emory University under the direction of Robert B. Platt in 1958.

He served as assistant and associate professor of biology at Alabama College (University of Montevallo) from 1958-1965. In 1966 he became professor and chairman of the biology department of Georgia College (Woman's College of Georgia).

He has served as a Director of N.S.F. Summer Institutes for high school science teachers and N.S.F. Undergraduate Research Participation Programs. He has been a Research Associate with both Emory University and the Institute of Radiation Ecology, Savannah River Ecology Laboratory. He has served as a staff member of the Commission on Undergraduate Education in the Biological Sciences. He is currently Director of Georgia College's Institute of Natural Resources and was named Georgia College Foundation Distinguished Professor for 1971-72. His area of

research interest is radiation ecology and he is author of eighteen articles.

He joined the Association of Southeastern Biologists in 1957 and has served on the Executive Committee (1963-65) and as treasurer (1968-71) and Vice President (1971-72). He has also served on an *ad hoc* committee on contact load and standards for biology departments in the southeast.

Richard E. Garth
(Vice-President)



Born in Tennessee and raised in Honolulu, he attended high school in Florida. He received his B. A. from Emory (1949), his M. S. from The U. of Tenn. (1950) and his Ph.D. in plant ecology from Emory (1954) where he worked on Spanish moss. He has taught at Bloomfield College in New Jersey, at Mount Union College in Ohio, three years at East Tennessee State and eight years at Northwestern State in Louisiana. He was Head of Biology at Mississippi State College for Women for three years and then moved to The University of Tennessee at Chattanooga as Head of Biology in 1969. He was on the staff of NSF for one year and is still a consultant to them. He has been a consultant to CUEBS, Xerox Education Division, and to the Science Education Department at Florida State University. He has been a test writer for BSCS and the Mid-Continent Regional Education Laboratory. His research interests have moved from plant ecology through developmental biology to endocrinology. He has had grants from NSF, NIH, the Louisiana Heart Association and HEW in addition to serving as director of numerous NSF-supported programs including SSTP, CCSS, URP and USEP.

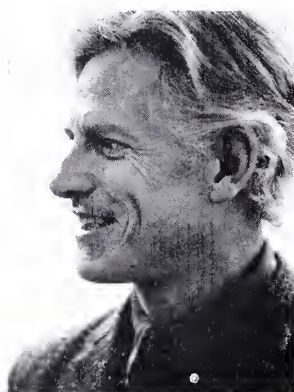
He has been a member of ASB since 1949, served on the Goethe Travel Awards Committee and was elected to a 3 year term on the Executive Committee in 1965. He is currently on the Research Awards Committee. Dr. Garth is Director of The Division of Science and Mathematics and Chairman of Biology at The University of Tennessee at Chattanooga.

John D. Withers
(Vice-President)

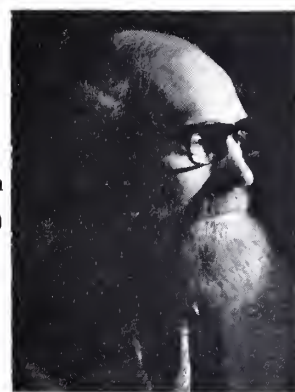


Dr. Withers is Assistant Director of the American Institute of Biological Sciences. He received the B. A. degree from Lincoln University (1948), and the M. S. (1949) and Ph.D. (1964) from West Virginia University. Dr. Withers has held positions of teacher at Lincoln High School, Wheeling, West Virginia; instructor at Barber Scotia College, North Carolina; and associate professor, professor, and Dean of the Faculty and Instruction at Clark College, Atlanta. He has also served as CUEBS Staff Biologist and is now in the Education Division of the AIBS.

Dr. Withers has been consultant to the Ford Foundation in Doctoral Fellowships for Black Students Program and to the Southern Association of Colleges and Schools. He is now consultant for the Michigan Consortium of Junior Colleges and a member of the Governor's Advisory Council on Environmental Affairs. He is the author of 11 publications.



John Cairns, Jr.
(Executive Committee)



Edward E. C. Clebsch
(Executive Committee)

Dr. Cairns acquired an A.B. at Swarthmore College and a M. S. and Ph.D. at the University of Pennsylvania. Cairns has been employed by the Academy of Natural Sciences, Temple University, Rocky Mountain Biological Laboratory, the University of Michigan, and the University of Kansas; he is presently Professor of Biology and Director, Center for Environmental Studies, Virginia Polytechnic Institute and State University.

Cairns is author or co-author of four books and monographs, eleven chapters in books, approximately 140 papers, and numerous abstracts (not associated with papers), book reviews, reports, and the like. In 1971 he received a Presidential Commendation from President Nixon "in recognition of exceptional service to others in the finest American tradition."

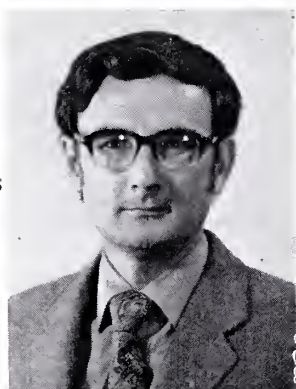
Dr. Clebsch received A.B. and M.S. degrees from the University of Tennessee and a Ph.D. in 1960 from Duke University. From 1960 through 1962 he was a research associate in botany at the University of Tennessee and since that time has been on the faculty.

He is a member of the Botanical Society of America (Education Committee member, 1965-'68); American Association for the Advancement of Science (Fellow); American Institute of Biological Sciences; British Ecological Society; Ecological Society of America (Editorial Board, 1970-'73); Society of American Foresters (Chairman, Natural Areas Committee, K-T Section, 1968-'70); Society of the Sigma Xi; Tennessee Academy of Science (Fellow); Tennessee Citizens for Wilderness Planning (Vice-President, 1971-'72); Wilderness Society; and other professional and service organizations.

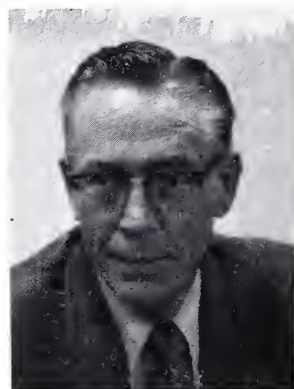
He has been a member of ASB since 1948, of the Research Awards Committee (1965-'67), and Chairman of the Conservation Committee since 1967.

His research interests in plant ecology include work in mineral cycling in the Southern Appalachians, Amchitka Island, arctic Alaska, and vegetation in the Great Smoky Mountains National Park.

Frank Overton Perkins
(Executive Committee)



John M. Rawls
(Executive Committee)



Dr. Frank O. Perkins is Head of the Department of Microbiology-Pathology, Virginia Institute of Marine Science, Gloucester Point and Assistant Professor at the College of William and Mary and the University of Virginia.

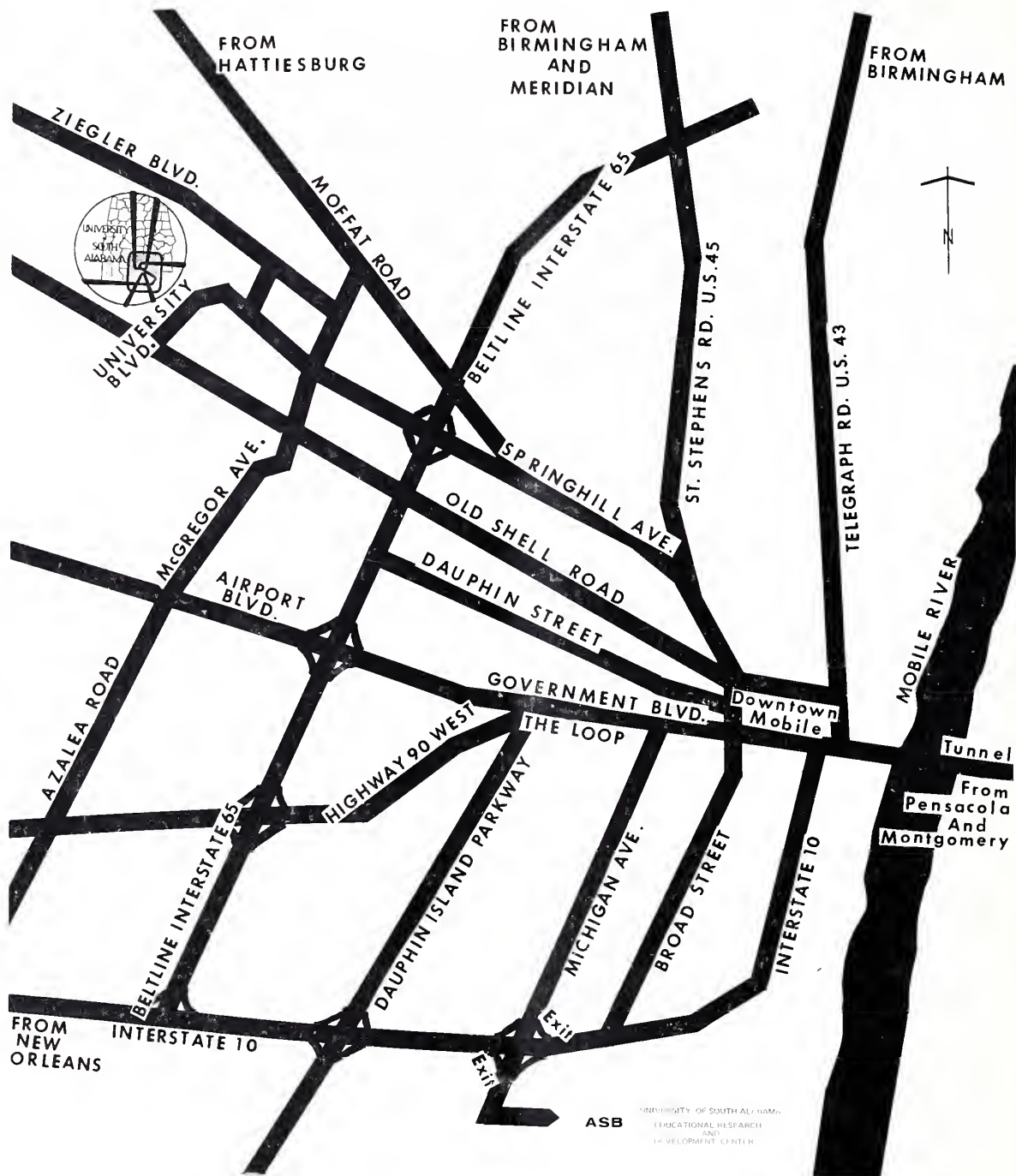
Born in Fork Union, Virginia, February 14, 1938, he received his A. B. from the University of Virginia in 1960 and M.S. and Ph.D. degrees from Florida State University in 1962 and 1966. He joined the Association of Southeastern Biologists in 1968 and is the member of eight other scientific societies.

His research has been supported by NSF and NASA grants; his interests include the fine structure, taxonomy, and ecology of marine Protozoa and fungi. Twenty research papers have been published by Dr. Perkins in these areas of investigation.

Dr. Rawls received two degrees, the B. S. and M. A., from George Peabody College for Teachers, and the Ph.D. from the University of Florida. From 1953 to 1957, and during the academic year 1961-62, he was a member of the faculty at Austin Peay State University. During the period September 1962 - June 1964 he was Associate Professor of Biology at Lamar State College of Technology. Dr. Rawls joined the faculty of the then-new University of South Alabama in June 1964 and was appointed Chairman of the Department of Biological Sciences in October of that year. He served as department chairman until January 1, 1972 at which time he resigned that position to devote full time to teaching. He is presently Professor of Biology.

Dr. Rawls' teaching and research interests are in genetics and developmental physiology.

He has been a member of the ASB since 1957 and is currently Co-Chairman of the Local Arrangements Committee for the 1972 ASB meeting.

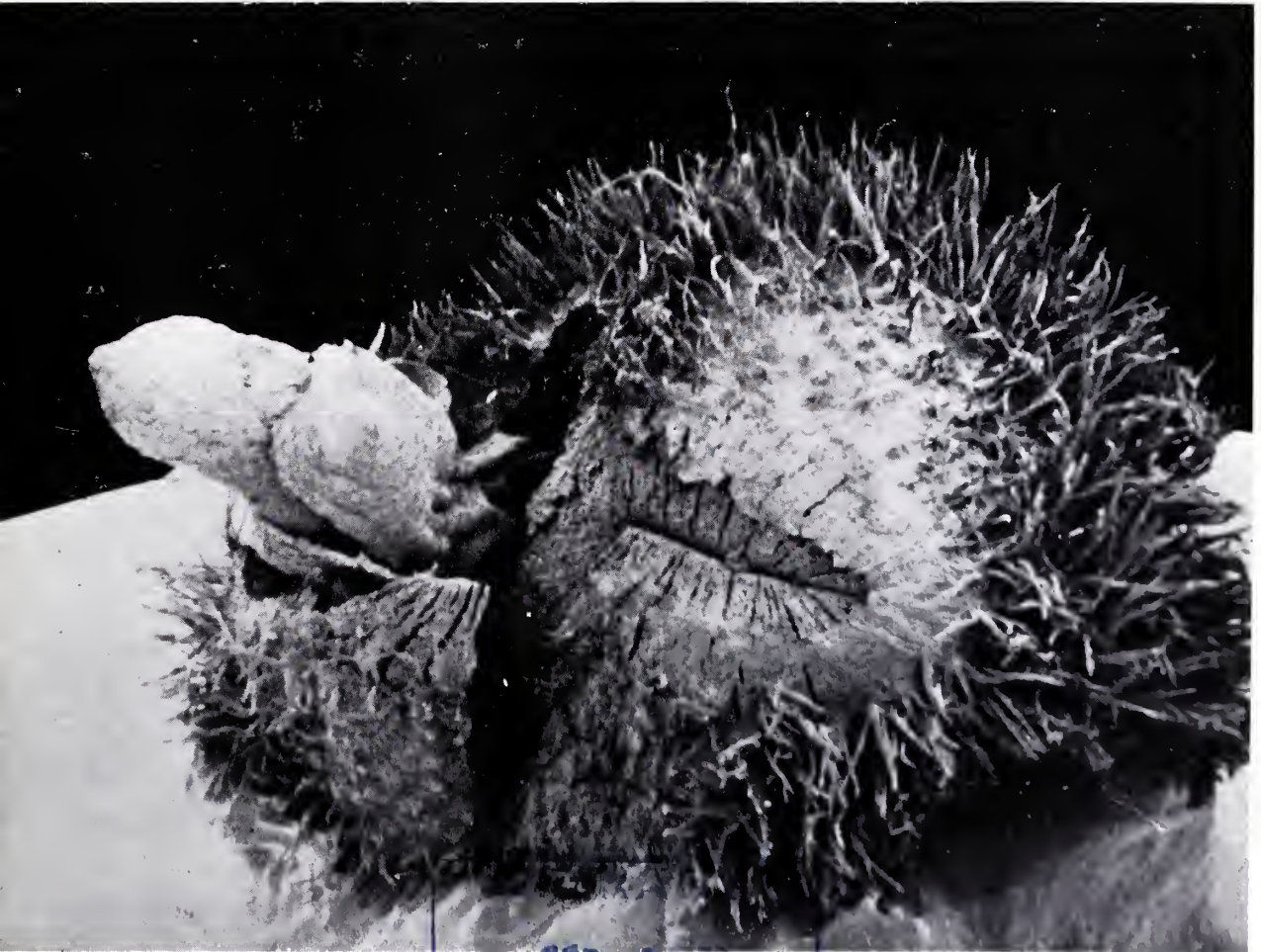


The ASB

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Volume 19, Number 3

July 1972



SEP 8 1972
Scanning electron micrograph of *Hibiscus militaris*

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CONTENTS

The Biologist's Responsibility To Industry: The Need for Reason and Understanding. — C. W. Hart, Jr.	123
An Ecologist's Guide to the Minnows of the Freshwater Drainage Systems of the Chesapeake Bay Area. — Jules J. Loos, William S. Woolcott, and Neal R. Foster	126
News of Biology in the Southeast	138

THE COVER

Scanning electron micrograph of a germinating seed of *Hibiscus militaris* Cav., courtesy of Dwayne A. Wise. The specimen was fixed in 0.45% glutaraldehyde, dehydrated through an alcohol series, and dried by the critical point method with CO₂. It was then mounted in silver epoxy, coated with 105 Å of gold-palladium (60% : 40%) and viewed with a Cambridge Stereo Scan Mark II A scanning electron microscope. Analysis of hard plant parts by this method requires a minimum of treatment and reveals maximum detail. The technical assistance of Mr. Ron Parker is acknowledged.

The Biologist's Responsibility to Industry: The Need for Reason and Understanding

C. W. HART, JR.

*Director of Consulting Programs
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The old saying, "You never miss the water till the well runs dry," might still bring forth a chuckle here and there—but the shortage of clean water, the disastrous lowering of the water table in many areas, and the incredible thirst exhibited by our industries is rapidly causing us to realize that it is no laughing matter.

When the ecologist looks at water pollution today, it can no longer be in the guise of an "ivory tower" scientist examining a phenomenon for its own sake. The point of view of today's ecologist must be broader, and must be guided by social as well as academic considerations. While those who seek his help may have specific problems which cry for answers, it often falls to the ecologist to demonstrate how specific pollution problems relate to areas which might never have occurred to those seeking his help. It is thus by social and economic awareness, as well as by his own specific field of endeavor, that today's ecologists must be guided.

The world now has 2.4 billion undernourished human inhabitants (as opposed to a mere 450,000,000 comparatively well fed ones). By the year 2000 it is estimated that the world's population will have doubled, but it is also estimated that

in the United States alone the total water available to us via precipitation on the land will suffice for only 50,000,000 additional people—a figure we will reach long before the year 2000.

Europe and the United States now re-use water in several river basins up to fifty times before it moves out to sea, and this re-use must be expanded considerably in the future to utilize, to its fullest, all available water.

With these few examples in mind, it is easy to see why the ecologist-conservationist of today must widen his perspective, must look at his environment from a broad *management* viewpoint as well as from the narrower legislative-biological viewpoint still thankfully prevalent.

In short, the stresses of dense population have forced us to change many of our ways of thinking. In order to support the densely populated areas that have developed today, the only rational approach to pollution is to *use* our waters, but to do so very carefully. And, in turn, this approach makes it even more imperative that natural areas in less densely populated regions be preserved—not only for esthetic reasons, but so that species diversity can be maintained, for species diversity is necessary for ecological stability.

Retiring President's Address, presented on 12 April 1972 at the 33rd annual meeting of the Association of Southeastern Biologists in Mobile, Alabama.

In the early days of our country, mismanagement of the natural environment was small when compared with the great area that was undisturbed. Man did not have to worry about pollution or the effects of his folly. But as society tried to support more and more people on less and less land, the effect of man's activities became more severe. Many towns had untreated sewage and all the wastes flowed into nearby streams. If the town was not very large the stream could assimilate it.

Likewise, small industries grew up on small streams. In the 18th century man did not know how to control the power of large waterways, and therefore it was necessary that industries grow up on these little streams. And gradually these streams have become more and more polluted.

In the early part of the 20th century many of our large cities had no sewage treatment and the rivers that once were relatively pure and could support many uses became open sewers.

The causes of this severe pollution were many, and have continued to multiply. We cannot say that pollution is due to any one cause, for almost every facet of civilization — if it is intensive and produces wastes that are in excess of what a stream can assimilate — will seriously affect the aquatic ecosystem. The farm, which used to be considered a symbol of healthy rural life, is today one of our worst sources of pollution. In the old days, a farmer in the mid-west expected to support one or two head of cattle per acre. Today, often a hundred to five hundred head of cattle are maintained on a single acre of land, and when one considers the estimate that each head of cattle is equal to 16.9 human beings in waste produced, then a hundred head of cattle would have a population equivalent — in the form of nitrates, phosphates, and other constituents — that equals the eutrophication produced by 1690 people with their wastes untreated. Should this number of cattle rise to 500, the equivalent would be about that of a human population of 9000 with untreated sewage.

A single hog produces the waste equivalent of approximately 1.9 human beings.

In the old days the ordinary farm supported perhaps 50 or 60 chickens. Today we sometimes

have as many as five thousand chickens on a single range. The waste equivalent of seven chickens is that of the waste of one human, and a single establishment may have 100,000 chickens.

And the farm may also have other pollution effects, such as the runoff of insecticides and fertilizers. Newspapers and popular magazines, as well as technical publications, provide almost daily accounts of present effects and predictions of dire consequences resulting from continued use of some of these chemicals.

And industry has grown beyond the capacities of many of the streams on which they are located. The small industry could use the small stream without harm to the aquatic life, but with increased demand for their products, industries have expanded on these same small streams so that it is no longer possible for all of their wastes to be discharged without defiling the water.

Now — the recently heralded Muskie Bill (HR 11896) stated that we must restore and maintain the chemical, physical, and biological integrity of our waterways. With this we must all agree. However, since we do not know how to produce the material things that we demand without generating pollution, a goal of *no pollution* by any foreseeable date — much less 1980 or 1985 — is simply irresponsible.

A realistic definition of pollution — such as the amount of a substance that decreases the diversity and productivity of an ecosystem — might help. This then, would not necessarily mean no discharges — but would mean that no pollutant could be put into a stream which significantly reduced its ecological diversity or its productivity.

The public's idea of what is polluting the environment bothers me. Ask that ubiquitous barometer the taxicab driver, and he gives a programmed response about evil industry. Ask the concerned housewife, and she tells you about dirty industry while washing her kitchen with detergent and disposable towels.

Rare is the person who says "I am a polluter," and does something about it. The polluter talks piously of thermal pollution while sitting in an

overlighted and overairconditioned room. The polluter righteously builds subways to alleviate automotive pollution, which merely moves the problem to someone else's backyard — because more electricity must be generated (and heat released to the waterways) to run the subway.

If we eliminate all industrial discharges tomorrow we would not eliminate pollution, because pollution comes from all aspects of our way of life: from the cultivation of land, the cutting of forests, the building of roads and houses, the sanitary wastes from those houses, transportation, *and* industry.

I have worked with industries and their pollution problems for 14 years. And the very fact that most industries I have worked with consulted us in the first place indicated their concern.

I say *most*, because I have seen my share of those who merely wanted to buy their way out of some flagrant environmental disaster. But it is not those industries with which I am concerned. I know that we environmentalists have worthy adversaries there, and I wish us godspeed in doing something about them.

I am concerned about those industries which *are* responsible citizens. For there are industries that have had the foresight to do, to the best of their ability, what they could to keep peace with the environment, and still pay their employees well.

I am concerned because credit should be given where it is due.

I am concerned because some politicians — and biopoliticians — are using biologists and industries indiscriminately as pawns in their own self-seeking games. Some, to be sure, are genuinely concerned; motives of others are questionable.

I am concerned that a new organism — the bandwagon-hopping biochamelcon — is evolving out of the effluent and is joining forces with the less savory politicians.

I am concerned because I see a backlash developing. The word "environmentalist" is becoming a dirty word among even responsible industries, and, as a consequence, we biologists are

losing our credibility with those we should be able to help and influence. We are losing this credibility because we often seem to be less than objective — to resort, on occasion, to what amounts to blackmail in attempting to get money from industry for ecological studies; the ploy being "you hire me and I can protect you from the officials."

Certainly this is not an everyday occurrence, but it does happen, and industries are not so obtuse as to be taken in by it.

We are losing credibility because some of us follow the lead of others and indiscriminately attack industries that are honestly trying to do a good job. Less conscientious industries watch such crucifixions and say to themselves "Why should we do anything? What they *might* do to us can't be any worse than that."

And, finally, we talk glibly about cleaning up things for posterity. As a consequence of our actions there is a new cry abroad in the land from those less responsible industries — "What the hell has posterity done for me lately?"

There are industries that I expect this from; I fear we will hear it from others.

In order to serve best the public interest, dispassionate scientific appraisal is sorely needed. We all know that change is constantly taking place, and change itself is natural. None of us has all the answers. Next year, or five years hence, we still won't have them. But decisions must be made — and no decision can be made without some risk.

Decisions require balanced judgment, and it is unfortunately almost impossible for the decision-maker to have all of the facts clearly unvarnished before him. This is true whether he be a scientist, government regulator, or industrialist . . . and the aspects that must be considered and balanced against each other include a tangle of technical, economic, and social values — which should be unencumbered with hysteria.

To arrive at a goal involving a common good, each of us needs to recognize what his specialty can contribute, to recognize that it is only a part of the problem . . . and possibly not even the most important.

An Ecologist's Guide to the Minnows of the Freshwater Drainage Systems of the Chesapeake Bay Area¹

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Among the freshwater fishes of North America, there are more species of minnows (family Cyprinidae) than representatives of any other family of fishes. About 200 species occur in the United States and Canada, and about 50 in Mexico. The large number of species makes identification of individual minnows a formidable task.

To those unfamiliar with the group, all minnows look superficially alike because most are relatively small (modal length three to four inches) and often the diagnostic characteristics of the species are hard to see. The identification of young and juvenile minnows may require a different set of diagnostic characters from that used for adults. For example, young specimens typically are more slender and have proportionately larger eyes than adults. Color patterns also change as the fish mature. Often the dark

lateral stripe and the dark spot at the base of the tail, both typical of the young of many minnow species, become less distinct or disappear as adulthood is attained. Genetic and/or environmental factors may cause variations among different populations of the same species. Color patterns which are quite distinct in specimens collected in clear water may be absent in specimens from turbid water. Body shape and countable characters such as the number of scales, fin rays and vertebrae also differ. Often specimens from mountain or more northern localities have higher counts than those from lowland or more southern localities. It is not surprising, therefore, that the keys to minnows of the United States by Moore (1968) and Eddy (1969), require the examination of internal characters such as the pharyngeal teeth and the length and configuration of the intestine.

One approach that can simplify problems of identification is the creation of regional keys so that the number of species is considerably reduced. This factor alone makes "keying out" much more rapid. In addition, in a smaller area the range of intraspecific variation is reduced. Reduced variation facilitates reliable identification on the basis of readily visible characters. This in turn makes the key suitable for identification

¹ We wish to thank wholeheartedly all those who helped in the preparation of this guide. Edward K. Jankowski offered much advice during the initial preparation. A portion of the key was tested by a group of high school students. Later, extensive testing was carried out by Tris O'Connell, who having no previous experience in fish identification, was able to use the key without reading into it information which she had already learned. Helen W. Loos graciously prepared most of the illustrations.

of living material in the field or laboratory. We believe there is a need for this type of guide for the Chesapeake area because of the increasing number of ecological studies being undertaken there. Identification of living material is particularly helpful in ecological studies because repeated heavy sampling may decimate a local population.

In this guide, which encompasses the minnows of river systems of Virginia, Maryland, Pennsylvania, and Delaware that empty into the Chesapeake Bay, 31 species are considered. Not included are species restricted to the upper Susquehanna River in New York, which may be found in the classic work, *Fishes of the Great Lakes Region*, by Hubbs and Lagler (1958).

Excessive technical terminology is avoided in the key, but a few basic terms must be defined

here. The names of the fins are as follows: the dorsal fin is the fin on the back; the caudal fin is the tail fin; the anal fin is the unpaired fin behind the anus; the pelvic fins are the paired fins located abdominally just in front of the anus; the pectoral fins are the paired fins located just behind the gill openings on the breast. The origin of a fin is the anteriormost part of the base of that fin. The lateral line is a series of pored scales on the side. A barbel is a soft whisker-like structure associated with the mouth.

The gross external appearance of minnows is sufficient to differentiate them from other, superficially similar families that occur in the area. The following is a list of these families and those characters that readily distinguish members in the Chesapeake area from minnow species:

- Clupeidae** (herrings) — belly compressed, its lower margin saw-toothed.
- Engraulidae** (anchovies) — strikingly large mouth extends almost to edge of gill cover.
- Umbridae** (mudminnows) — round caudal fin; mouth extends past eye.
- Amblyopsidae** (cavefishes) — no pelvic fins; a series of dark stripes on side.
- Cyprinodontidae** (killifishes) — round caudal fin; groove between upper jaw and snout on upper surface of head; no dark bar under eye.
- Atherinidae** (silversides) — two dorsal fins; exceedingly well defined silvery stripe.
- Poeciliidae** (livebearers) — round caudal fin; dark bar under eye.
- Catostomidae** (suckers) — mouth on underside of head with roughened fleshy lips.

In minnows the belly is rounded; the mouth does not extend past the eye; the caudal fin is forked; pelvic fins are present; there is only one dorsal fin; a silvery stripe, if present, is poorly defined; there is no dark bar below the eye and the lips are never roughened as in suckers.

Introduced species are not included in the key. They may be distinguished from native species as follows: carp, *Cyprinus carpio* Linnaeus, goldfish, *Carassius auratus* (Linnaeus), and the ide, *Leuciscus idus* (Linnaeus), are characterized by a long dorsal fin whose base covers nearly half of the back between the head and caudal fin; the tench, *Tinca tinca* (Linnaeus) has very small scales, over 100 in the lateral line, and a barbel.

The native species which are included in the key are given below with their common names. The names follow the list by Bailey, *et al.* (1970)

published by the American Fisheries Society. Two recent changes are noted: the genus *Chrosomus* was synonymized with the Eurasian genus *Phoxinus* and the genus *Nocomis* was separated from *Hybopsis*.

Order Cypriniformes

Family Cyprinidae

Camptostoma anomalum (Rafinesque), stoneroller
Clinostomus elongatus (Kirkland), reidside dace
C. funduloides Girard, rosyside dace
Ercymba buccata Cope, silverjaw minnow
Exoglossum maxilligua (Lesueur), cutlips minnow
Hybognathus nuchalis Agassiz, silvery minnow
Nocomis leptcephalus (Girard), bluehead chub
N. micropogon (Cope), river chub
N. raneyi Lachner and Jenkins, bull chub
Notemigonus crysoleucas (Mitchill), golden shiner
Notropis amoenus (Abbott), comely shiner
N. aulostanus (Girard), satinfin shiner

N. ardens (Cope), rosefin shiner
N. bifrenatus (Cope), bridle shiner
N. cerasinus (Cope), crescent shiner
N. chalybaeus (Cope), ironcolor shiner
N. cornutus (Mitchill), common shiner
N. hudsonius (Clinton), spottail shiner
N. procne (Cope), swallowtail shiner
N. rubellus (Agassiz), rosyface shiner
N. semperasper Gilbert, roughhead shiner
N. spilopterus (Cope), spotfin shiner
Phoxinus erythrogaster (Rafinesque), southern red-belly dace
P. oreas (Cope), mountain redbelly dace
Pimephales notatus (Rafinesque), bluntnose minnow
P. promelas Rafinesque, fathead minnow
Rhinichthys atratulus (Hermann), blacknose dace
R. cataractae (Valenciennes), longnose dace
Semotilus atromaculatus (Mitchill), creek chub
S. corporalis (Mitchill), fallfish
S. margarita (Cope), pearl dace

Hybridization among minnows is not unusual and therefore, specimens that do not conform to the key should be suspect. One of the most common hybrid combinations found in the area

is *Notropis rubellus* x *Notropis cornutus*. It is similar in appearance to *Notropis rubellus* or *amoemus* but has a broad dark or silvery mid-dorsal stripe. It has been reported from the James by Rancey (1950), from the Rapidan River of the Rappahannock by Millsaps (manuscript in preparation), and from the little Patuxent by Tsai and Zeisel (1969). The list of natural hybrid combinations that have been reported among minnows is long. Crosses often occur among fishes that lay eggs over pebble nests because a nest built by one species may be used simultaneously by a number of other species for spawning. Members of the following genera: *Camptostoma*, *Clinostomus*, *Exoglossum*, *Nocomis*, *Phoxinus*, *Rhinichthys* and *Semotilus*, and the following species in the genus *Notropis*: *amoemus*, *ardens*, *cerasinus*, *cornutus*, *rubellus* and presumably, *semperasper* — use this type of nest. In addition, there is hybridization between *Pimephales notatus* and *promelas*, and between *Notropis analostanus* and *spilopterus*.

KEY TO THE MINNOWS OF THE CHESAPEAKE DRAINAGE SYSTEMS IN VIRGINIA, MARYLAND, PENNSYLVANIA, AND DELAWARE

- 1a "Deformed" lower lip with indented tongue-like center (Fig. 1) eutlips minnow (*Exoglossum maxillingua*)
 Dusky, often with purplish sheen in life. Widely distributed riffle species. Total length up to 6 inches.
 b Lower lip not "deformed" 2



Fig. 1. — *Exoglossum maxillingua*, underside of head.

- 2a (1)² Hard cartilaginous front margin of lower lip separated by a groove from loose fleshy covering (Figs. 2 and 3) stoneroller (*Campostoma anomalum*)
Often with randomly scattered darkened scales; may have blotch on dorsal fin. James and Potomac. Riffle species. Total length up to 9.5 inches.
- b Laeks groove around front end of lower jaw 3

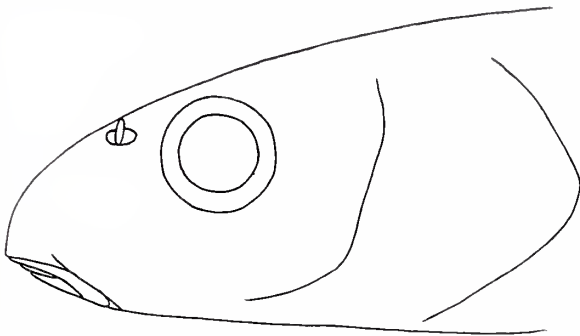


Fig. 2. — *Campostoma anomalum*, 2.4 inches, TL.

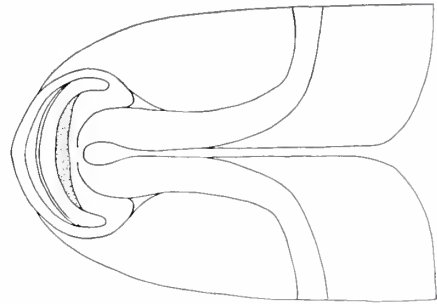


Fig. 3. — *Campostoma anomalum*, underside of head.

- 3a (2) Origin of dorsal fin slightly behind a vertical line through posterior end of pelvic fin base (Fig. 4); or, modally nine or more scales between lateral line and origin of dorsal fin 4
- b Origin of dorsal fin in front of a vertical line through posterior end of pelvic fin base; scales large, modally eight or fewer between lateral line and origin of dorsal fin 18
- 4a (3) Lateral line curves downward strongly, dips onto lower third of body (Fig. 5); unscaled ridge or "keel" between pelvic fins and anus (Fig. 6) golden shiner (*Notemigonus crysoleucas*)
Specimens under 2 inches long relatively slender; larger specimens, slab-sided (Fig. 5). Widely distributed, especially in slow or still waters. Total length up to 10.5 inches.
- b Lateral line does not dip onto lower third of body; belly laeks "keel" described above 5

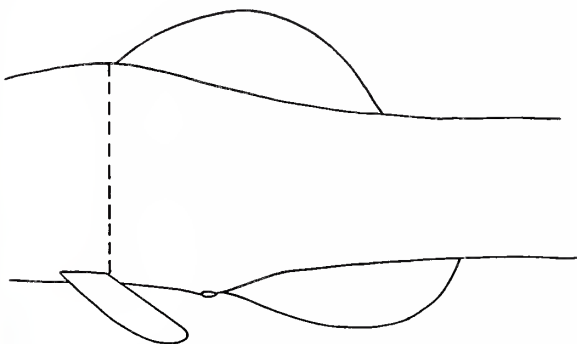


Fig. 4. — Dorsal fin position relative to that of pelvic fin.

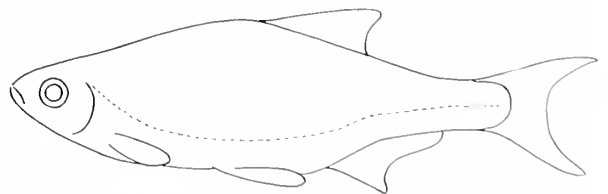


Fig. 5. — *Notemigonus crysoleucas*, 4.2 inches, FL.

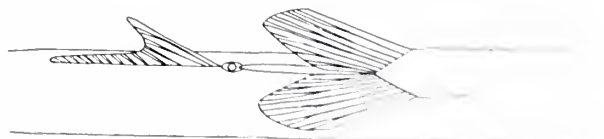


Fig. 6. — *Notemigonus crysoleucas*, "keel".

² The number or numbers in parentheses with a given couplet indicates one or more choices which may have directed the user to that couplet.

- 5a (4) Dark lateral stripe completely continuous around front of snout; stripe distinct even on tip of snout above upper jaw 11
- b Dark lateral stripe, if present, not continuous around snout; end of snout above upper jaw may be dusky, but is uniformly so 6
- 6a (5) Mouth large, length of upper jaw about one third length of head; front of mouth at end of snout 7
- b Mouth small, length of upper jaw considerably less than one third length of head; front of mouth often slightly behind end of snout 8
- 7a (6) Scales small, modally nine or more between lateral line and origin of dorsal fin; body more robust (Figs. 7 and 8); often with randomly scattered darkened scales on side 9
- b Scales large, modally eight or fewer between lateral line and origin of dorsal fin; body elongate (Fig. 9); never with darkened scales scattered on side 35
- 8a (6) Scales small, modally nine or more between lateral line and origin of dorsal fin; often with darkened scales or dark blotches on side 11
- b Scales large, modally eight or fewer between lateral line and origin of dorsal fin; never with darkened scales or dark blotches on side 18
- 9a (7) Front tip of lower jaw well above level of lower edge of eye (Figs. 10 and 11); often pectoral fin extends approximately to base of pelvic fin; often with randomly scattered darkened scales on side 10
- b Front tip of lower jaw on same level as, or below, lower edge of eye (Fig. 12); pectoral fin extends two thirds distance to pelvic fin base or less; never with randomly scattered darkened scales on side 17

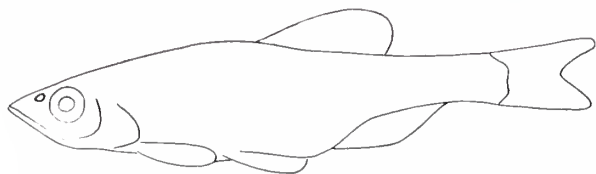


Fig. 7. — *Clinostomus elongatus*, 2.6 inches, TL.

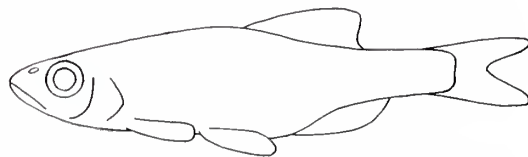


Fig. 8. — *Clinostomus fuuduloides*, 3.0 inches, TL.



Fig. 9. — *Notropis rubellus*, 2.5 inches, TL.

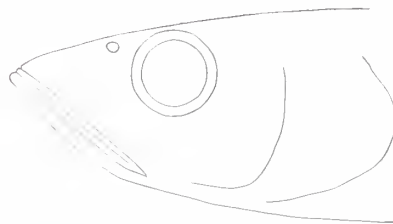


Fig. 10. — *Clinostomus elongatus*, 2.6 inches, TL.

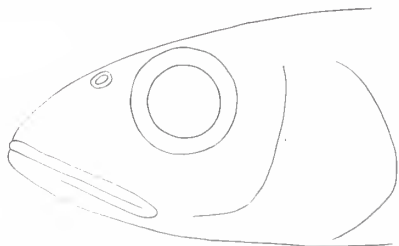


Fig. 11. — *Clinostomus fuuduloides*, 2.9 inches, TL.

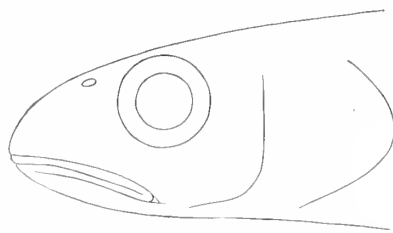


Fig. 12. — *Semotilus atromaculatus*, 2.9 inches, TL.

- 10a (9) Lateral profile of front of head pointed; front tip of lower jaw extends conspicuously in front of upper jaw (Fig. 10); less robust (Fig. 7) redside dace (*Clinostomus elongatus*)
- b Lateral profile of front of head rounded; front tip of lower jaw even with or slightly in front of upper jaw (Fig. 11); more robust (Fig. 8) rosyside dace (*Clinostomus funduloides*)
- Widely distributed. Total length up to 4.5 inches.
- 11a (5;8) Mouth on underside of head behind greatly protruding snout (Fig. 13) longnose dace (*Rhinichthys cataractae*)
- Head with "shark-like" lateral profile. In the genus *Rhinichthys* the groove that separates the upper jaw from the snout does not continue around the front end of the upper jaw (Fig. 14). Widely distributed riffle species. Total length up to 4.5 inches.
- b Mouth at end of snout or slightly behind it 12

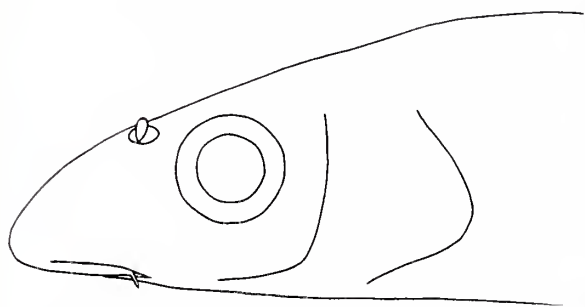


Fig. 13. — *Rhinichthys cataractae*, 2.6 inches, TL.

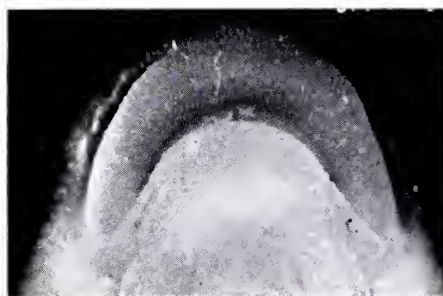


Fig. 14. — *Rhinichthys cataractae*, mouth.

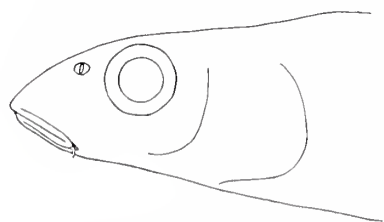


Fig. 15. — *Rhinichthys atratulus*, 2.8 inches, TL.

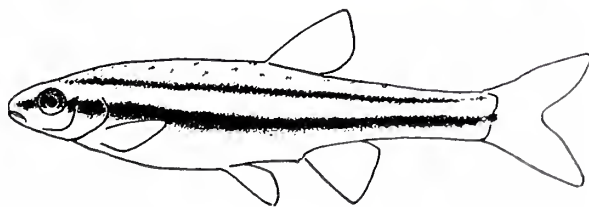


Fig. 16. — *Phoxinus erythrogaster*, 2.5 inches, TL.

- 12a (11) Front tip of lower jaw slightly behind end of snout; barbel located at posterior end of jaw (Fig. 15) blacknose dace (*Rhinichthys atratulus*)
- Often with distinctive cinnamon brown cast in life. The black lateral stripe common to many minnow species is particularly pronounced in specimens of this species under 2 inches long. Widely distributed. Total length up to 4 inches.
- b Front tip of lower jaw even with end of snout; lacks barbel at posterior end of jaw, but may have a tiny one in the groove above the upper jaw in advance of its posterior end 13
- 13a (12) Scales so minute that moist specimens appear scaleless; often with dark spots in one or more horizontal lines along upper back (Fig. 16) 14
- Approximately 65 or more scales in lateral series.

- b Scales clearly visible in specimens over 1.5 inches long; lacks dark spots in one or more horizontal lines along upper back but may have dark spots randomly scattered on side **15**
Approximately 60 or fewer scales in lateral series.
- 14a (13) James, York and Rappahannock. In specimens over 2 inches long, dark lateral stripe often splits into two parts above base of pelvic fins
..... mountain redbelly dace (*Phoxinus oreas*)
Not confined to mountain areas as common name implies. Total length up to 3 inches.
- b Susquehanna, Patapseo and Potomac. In specimens over 2 inches long, two separate parallel dark lateral stripes (Fig. 16)
..... southern redbelly dace (*Phoxinus erythrogaster*)
Total length up to 3 inches.
- 15a (13) Scales large, seven or fewer between origin of dorsal fin and lateral line; body elongate **27**
- b Scales small, nine or more between origin of dorsal fin and lateral line; body robust **16**
- 16a (15) Mouth small, posterior end of jaw does not extend past level of front margin of eye (Fig. 17); lacks dark spot on lower front of dorsal fin
..... pearl dace (*Semotilus margarita*)
Often with randomly scattered dark spots on side. Susquehanna and Potomac. Total length up to 3 inches.
- b Mouth large, posterior end of jaw extends approximately to below level of pupil (Fig. 12); sometimes with a small dark spot on lower front of dorsal fin **17**
- 17a (9;16) Dark spot on lower front of dorsal fin in specimens over 2 inches long; origin of dorsal fin slightly behind pelvic fin base
..... creek chub (*Semotilus atromaculatus*)
Lateral line scales, 50 or more. The genus *Semotilus* is characterized by a tiny barbel located in the groove above the upper jaw in advance of its posterior end; but it is difficult to see except in large specimens. Widely distributed. Total length up to 12.5 inches.
- b Lacks dark spot on lower front of dorsal fin; origin of dorsal fin usually over pelvic fin base **33**
Lateral line scales about 45 or fewer.
- 18a (3;8) Front tip of lower jaw well above level of lower edge of eye (Figs. 18 and 19) **19**
- b Front tip of lower jaw on same level as, or below, lower edge of eye **22**

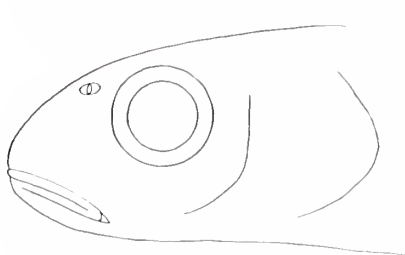


Fig. 17. — *Semotilus margarita*, 2.2 inches, TL.

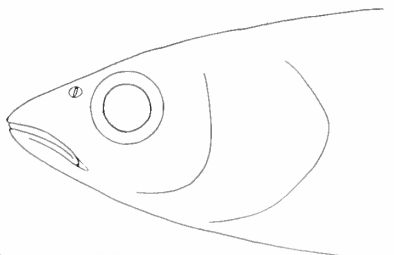


Fig. 18. — *Notropis spilopterus*, 4.0 inches, TL.

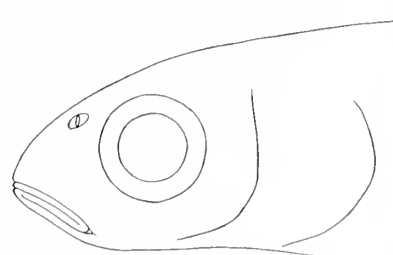


Fig. 19. — *Notropis spilopterus*, 1.8 inches, TL.

- 19a (18) Pattern suggesting crisscrossing diagonal lines ("crosshatching") covers upper two thirds of side (Fig. 20); sometimes with elongate dark blotches on posterior dorsal fin (Figs. 21 and 22) 20
- b "Crosshatching", if present, covers little more than upper half of side; never with elongate dark blotches on posterior dorsal fin 24
- 20a (19) Depth of lateral line scales under dorsal fin about two times the exposed horizontal length of the scale; usually elongate blotches on posterior dorsal fin in specimens over 1.5 inches long 21
- b Depth of lateral line scales under dorsal fin three to four times the exposed horizontal length of the scale (Fig. 23); lacks elongate dark blotches on posterior dorsal fin 34
- 21a (20) In specimens over 1.5 inches long, membranes between first three principal dorsal fin rays lack pigment (Fig. 21) except in breeding males (which have tubercles on upper surface of head) spotfin shiner (*Notropis spilopterus*)
- Lateral line scales usually 37 to 39, modally 38 (Gibbs, 1963). Potomac and Susquehanna. Total length up to 4 inches. In *spilopterus* and *analostanus*, because of a protracted spawning period, small specimens are often collected throughout the summer; also in both species adults often with steel-blue or purplish cast and satiny fins in life.
- b In specimens over 1.5 inches long, dorsal fin with all membranes at least moderately pigmented (Fig. 22) satinfish shiner (*Notropis analostanus*)
- Lateral line scales usually 35 to 37, modally 36. Widely distributed. Total length up to 3.5 inches.

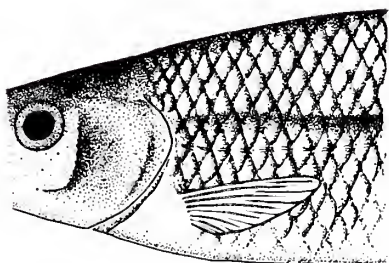


Fig. 20. — *Notropis spilopterus*, "crosshatching" on side.

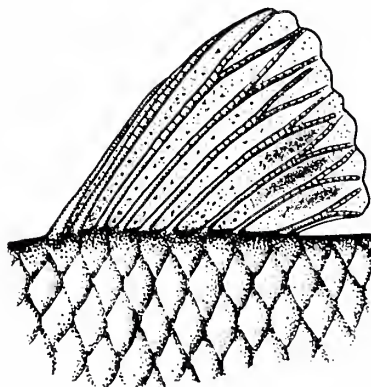


Fig. 22. — *Notropis analostanus*, dorsal fin.

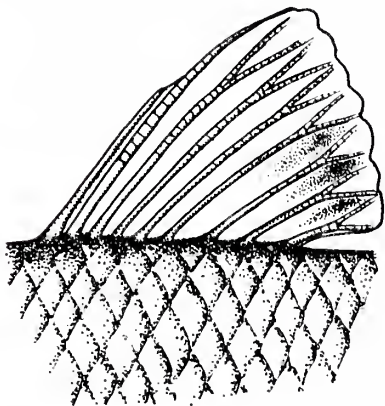


Fig. 21. — *Notropis spilopterus*, dorsal fin.

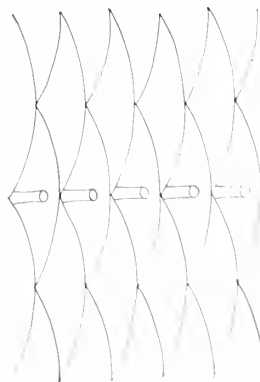


Fig. 23. — *Notropis cornutus*, lateral line scales

- 22a (18) Barbel located at posterior end of jaw (Fig. 24) 23
 b Laeks barbel at posterior end of jaw; however, there may be a tiny barbel located in the groove above the upper jaw in advance of the posterior end of the jaw 24

- 23 (22) Trichotomous couplet.
 a James, York, upper Rappahannock and upper Potomac.
Specimens over 5 inches long: breeding males with tubereles on top of head, some in front of eyes, none between nostrils; females and non-breeding males often with white spots or tuberele scars in a similar position (Fig. 25). Iris red in life.
Specimens under 5 inches long: (If breeding tubereles or associated markings are not present, an internal character is required.) Intestine whorled; its loops cover "stomach", often can be seen through body wall or can be verified by dissection bluehead chub (*Nocomis leptocephalus*)
 Total length up to 10 inches.

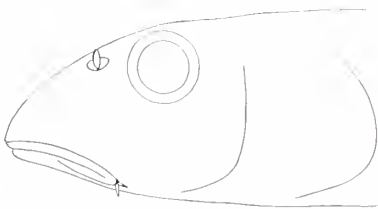


Fig. 24. — *Nocomis micropogon*, 3.1 inches, TL.

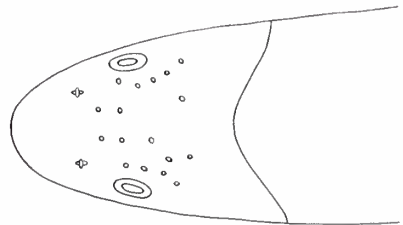


Fig. 25. — *Nocomis leptocephalus*, 5.7 inches, TL.

- b Widely distributed.
Specimens over 5 inches long: breeding males with tubereles on snout, in front of and between nostrils, usually none between eyes; females and non-breeding males with white spots or tuberele scars in a similar position (Figs. 26 and 27). Iris golden in life.
Specimens under 5 inches long: intestine not whorled, a simple elongate branch parallels body axis river chub (*Nocomis micropogon*)
 Total length up to 12.5 inches.

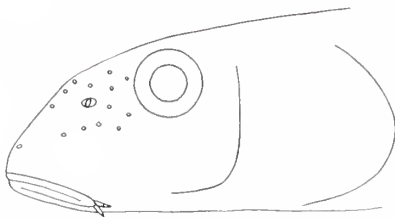


Fig. 26. — *Nocomis micropogon*, 7.2 inches, TL.

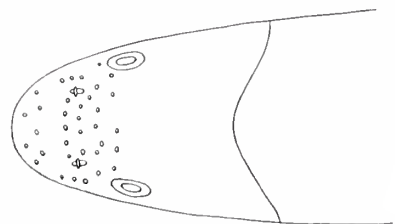


Fig. 27. — *Nocomis micropogon*, 6.1 inches, TL.

- c James.
Specimens over 5 inches long: breeding males with many tubereles from in front of nostrils to behind eyes; females and non-breeding males with white spots or scars in a similar position. Iris golden in life.
Specimens under 5 inches long: similar to *micropogon*; mouth narrower. (See Laehner and Jenkins, 1971) bull chub (*Nocomis raneyi*)

Although the ranges of *raneyi* and *micropogon* overlap, they rarely occur in the same collection. Atypical specimens intermediate between *raneyi* and *micropogon* in some characters including tubercles were described by the above authors from the James River. They did not attribute this fact to hybridization. Total length up to 12.5 inches.

- 24a** (19;22) Scales on back behind head distinctly crowded (Fig. 28), considerably smaller than those on side; often with a dark blotch on front of dorsal fin **25**
- b** Scales on back behind head not distinctly crowded; lacks dark blotch on dorsal fin **26**
- 25a** (24) Lateral line complete; dark spot at base of caudal fin bluntnose minnow (*Pimephales notatus*)
- The dark spot at the base of the caudal fin, present in many minnow species, is particularly prominent in this species even in adults. Widely distributed. Total length up to 4.5 inches.
- b** Lateral line incomplete; generally lacks dark spot at base of caudal fin except in young fathead minnow (*Pimephales promelas*)
- Susquehanna and Potomac; possibly introduced elsewhere, i.e., near Stevensville in Mattaponi River of York where used at hatchery as a food fish. Total length up to 3.5 inches.
- 26a** (24) A prominent dark lateral stripe continuous around front of head on chin or snout **27**
- b** Dark lateral stripe, if present, not continuous around front of head on chin or snout **28**
- 27a** (15;26) Dark lateral stripe completely continuous around snout, distinct on tip of snout but absent on chin (Fig. 29) bridleshiner (*Notropis bifrenatus*)
- Widely distributed. Total length up to 2 inches.
- b** Dark lateral stripe completely continuous around front of head on chin and snout (Fig. 30) ironcolor shiner (*Notropis chalybaeus*)
- Widely distributed. Total length up to 2 inches.
- 28a** (26) Underside of head noticeably flattened; bone on lower part of head with a series of chambers that are visible through skin (Fig. 31) silverjaw minnow (*Ericymba buccata*)
- b** Underside of head rounded; lacks series of chambers along lower part of head **29**

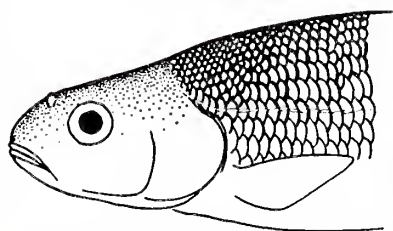


Fig. 28. — *Pimephales promelas*, 2.7 inches, TL.

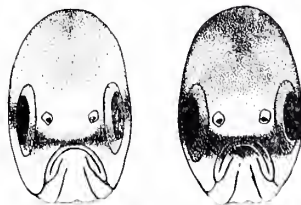


Fig. 29. — *Notropis bifrenatus*, front of head.

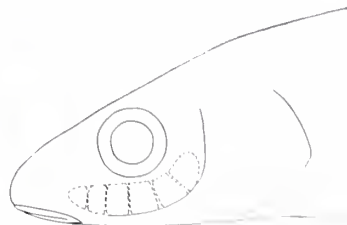


Fig. 30. — *Notropis chalybaeus*, front of head.

Fig. 31. — *Ericymba buccata*, 1.8 inches, TL

- 29a (28) Posterior end of jaw extends past level of front margin of eye 32
 b Posterior end of jaw barely reaches level of front margin of eye or fails to reach it
 (Figs. 32 and 33) 30

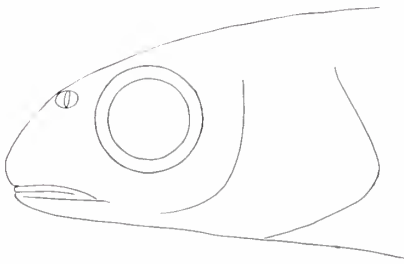


Fig. 32. — *Notropis hudsonius*, 3.0 inches, TL.

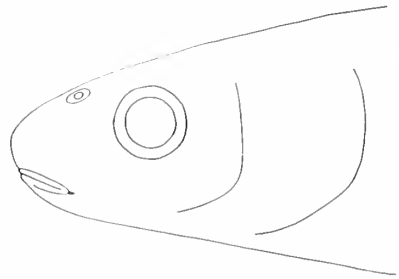


Fig. 33. — *Hybognathus nuchalis*, 2.9 inches, TL.

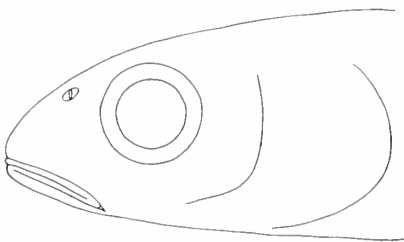


Fig. 34. — *Notropis cornutus*, 2.7 inches, TL.

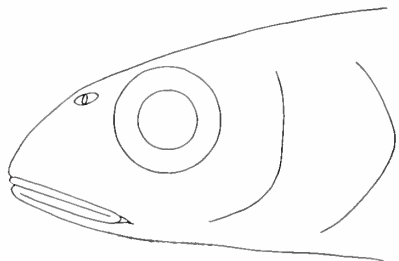


Fig. 35. — *Semotilus corporalis*, 2.6 inches, TL.

- 30a (29) Diameter of eye more than half the depth of head at eye (Fig. 32); lateral line
 often outlined by a series of paired dark spots resembling "equals" symbols 31
 b Diameter of eye about one half the depth of head at eye (Fig. 33); lateral line
 not outlined by a series of dark spots 32
- 31a (30) Back between head and dorsal fin dusky; scale pattern there often obscured
 spottail shiner (*Notropis hudsonius*)
 Usually eight principal anal rays. Widely distributed. *Notropis hudsonius*, *Hybognathus*
nuchalis and *Notemigonus crysoleucas* have fairly high salinity tolerances and are often
 found in slightly brackish water, but are also common in upstream locations. *Notropis*
hudsonius is a larger species than *procne*; initial differentiation can often be done on the
 basis of size. Total length up to 6 inches.
- b Back between head and dorsal fin straw colored; scale pattern there distinct
 swallowtail shiner (*Notropis procne*)
 Usually seven principal anal rays. Widely distributed; often over sandy bottom. Total
 length up to 3 inches.
- 32a (29;30) Posterior end of jaw extends about one half distance to front of eye (Fig. 33)
 silvery minnow (*Hybognathus nuchalis*)
 Widely distributed. Total length up to 5 inches.
- b Posterior end of jaw extends approximately to level of front of eye (Figs. 34 and
 35) 33

- 33a (17;32)** *Specimens over 4 inches*: depth of lateral line scales below dorsal fin three to four times the exposed horizontal length (Fig. 23); usually darkened scales or crescents on side.
Specimens under 4 inches long: front tip of lower jaw well above level of lower edge of eye (Fig. 34) **34**
- b** *Specimens over 4 inches long*: depth of lateral line scales below dorsal fin about two times the exposed horizontal length; lacks darkened scales or crescents on side.
Specimens under 4 inches long: front tip of lower jaw on same level as, or slightly below, lower edge of eye (Fig. 35) fallfish (*Semotilus corporalis*)
 Bluish to turquoise sheen in life. Widely distributed. Total length up to 18 inches; our largest eastern minnow.
- 34a (20;33)** Upper James (Ross, 1969). Similar to *cornutus* except dark crescent-shaped markings are more conspicuous crescent shiner (*Notropis cerasinus*)
 Number of scales around the circumference of the body just in front of dorsal fin usually 25 to 28 (Gilbert, 1964). Males more intense pink and black at spawning than *cornutus*. Total length up to 4.5 inches.
- b** Crescent shaped markings, if present, not as prominent common shiner (*Notropis cornutus*)
 Number of scales around the circumference of the body just in front of dorsal fin usually 30 to 35. Adults of *cerasinus* and *cornutus* more slab-sided than young; mouth on a level with eye in young, may be below eye in adults. Widely distributed. Total length of *cornutus* up to 9 inches.
- 35a (7)** Dark spot on lower front of dorsal fin rosefin shiner (*Notropis ardens*)
 James. Total length up to 3.5 inches.
- b** Lacks dark spot on lower front of dorsal fin **36**
- 36a (35)** Minute prickles on top of head roughhead shiner (*Notropis semperasper*)
 Upper James. Total length up to 3.5 inches. (Gilbert, 1961).
- b** Lacks minute prickles on top of head (but breeding tubercles present in males in spring) **37**
- 37a (36)** Small dark spots form V-shaped marking extending back from lower lip on underside of head (Fig. 36); males never with rosy coloration on head and body in spring. (Snelson, 1968.) comely shiner (*Notropis amoenus*)
 Widely distributed. Total length up to 4.5 inches.

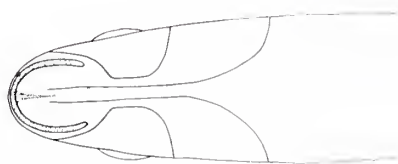


Fig. 36. — *Notropis amoenus*, underside of head.

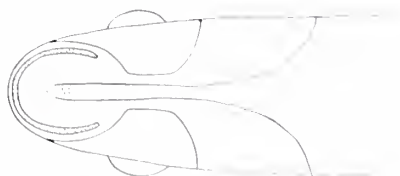


Fig. 37. — *Notropis rubellus*, underside of head.

- b Lacks V-shaped marking extending back from tip of lower jaw; area may be pale or pigmented (Fig. 37). Males with rosy coloration on head and body in spring rosyface shiner (*Notropis rubellus*)
See Fig. 9. Widely distributed. Total length up to 3.5 inches.

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News of Biology in the Southeast

STATE CORRESPONDENTS

Alabama — James Wilkes, Troy State Univ.
Florida — Position vacant
Georgia — Fred K. Parrish, Georgia State University
Kentucky — Gary E. Dillard, Western Kentucky University
Louisiana — Harry J. Bennett, Louisiana State University

Mississippi — Crawford G. Jackson, Jr., Mississippi State College for Women
North Carolina — Position vacant
South Carolina — G. Thomas Riggan, Jr., Newberry College
Tennessee — Position vacant
Virginia — Jean Pugh, Christopher Newport College

West Virginia — Position vacant

Crawford G. Jackson, Jr. — Editor
Department of Biological Sciences
Mississippi State College for Women
Columbus, Mississippi 39701

About People

Tom K. Scott has been appointed Chairman of the Department of Botany at the University of North Carolina, Chapel Hill, effective May 15, 1972. He succeeds Dr. Victor A. Greulach who has been Chairman since 1960. Dr. Scott has been awarded a Fulbright Senior Lectureship and will be on leave to Aegean University in Turkey during the 1972-73 academic year. During his absence, Dr. Edward G. Barry will serve as Acting Chairman.

E. S. Luttrell, University of Georgia, was elected President-Elect of the Mycological Society of America at its annual meeting. Richard T. Hanlin, also University of Georgia, has been promoted to Professor of Botany and Plant Pathology. Both presented symposium papers at the First International Mycological Congress in England.

William J. Darby, Department of Nutrition, Vanderbilt Medical School, received the Spicer Award for "Outstanding achievement in agricultural and food chemistry." The award, made through the American Chemical Society, consists of \$1,000 and a bronze medal.

Jim R. Massey who recently received his Ph.D. from the University of Oklahoma, has been appointed Curator of the Herbarium in the Department of Botany at the University of North Carolina, Chapel Hill.

New staff additions to the Department of Biology at Atlanta University are: **Dr. John M. Browne** (developmental biology), Associate Professor; **Dr. Joseph Myers, Sr.** (comparative physiology), Assistant Professor; **Dr. John Ruffin** (plant systematics), Assistant Professor.

Robert Stiles will join the Department of Biology, Samford University, in September. He replaces **William Mike Howell** who has accepted a position at Cornell University.

Ken Wagner has accepted a one-year appointment as Assistant Professor in the Department of Biology, Southwestern College at Memphis. **Robert L. Amy** returns to Southwestern in August following his sabbatical leave in France.

Lloyd Chesnut, formerly of Florida Technological University, will join the staff of the Department of Biology at Georgia College. Dr. Chesnut will serve as Director of the Institute of Natural Resources. **David Staszak**, formerly of MacMurray College, joins the Department as Assistant Professor. Dr. Staszak's specialty is physiology. **David J. Cotter** was named Georgia College Foundation Distinguished Professor for 1971-72.

New appointments in the Department of Botany, North Carolina State University, Raleigh, are: **Dr. Harriet Barclay** (University of Tulsa), Visiting Professor of Botany, 1972-73; **Dr. Bruce Mainsbridge** (University of Papua and New Guinea), Visiting Professor of Botany, 1972-73; **Dr. Arnold Krochmal** (U.S. Forest Service), Adjunct Professor of Botany.

Jane Scott (Ph.D., University of Kentucky) has accepted a one-year appointment in the Department of Biology at Eastern Kentucky University.

Larry Campbell (Ph.D., Indiana University), and **John R. Tripp** (Ph.D., Ohio State University) join the Department of Biology faculty at Florida Southern College. Their respective interests are cellular physiology and embryology.

Dr. Nancy P. Groseclose was appointed Chairman of the Department of Biology at Agnes Scott College in the fall of 1971, replacing **Josephine Bridgman**. Dr. Bridgman will continue her work as Professor of Biology. **Sandra T. Bowden** has been promoted to Asso-

ciate Professor. **Dr. Thomas Simpson**, presently at Wake Forest College, will join the Agnes Scott faculty as Assistant Professor in the fall of 1972.

David T. Rogers, Department of Biology, University of Alabama, Tuscaloosa, has received a \$19,347 grant from the U.S. Corps of Engineers to survey the bird fauna along the route of the proposed Tennessee-Tombigbee Waterway.

Paul C. Bailey, formerly Chairman of the Department of Biology, Birmingham-Southern College, has been appointed Dean of the College. **Dr. Thomas Quarles** is serving as Acting Chairman of the Department. **Dan C. Holliman** has been appointed Director of the Interim Term Program. **Leslie D. Zettergren** (Ph.D. candidate, Tulane University) joins the Department in September as Assistant Professor.

Mary Noka Hood, Professor of Microbiology, and **Grace Madsen**, Associate Professor of Botany, are retiring from the Department of Biological Science, Florida State University. Dr. Hood has been on the faculty since 1938; Dr. Madsen joined the faculty in 1940. Beginning with Quarter IV, 1972, **Thomas Peter Bennett** will assume the position as Chairman of the Department. Dr. Bennett comes from the University of Kentucky where he is presently Professor of Biology. **Donald R. Strong, Jr.** (Ph.D., University of Oregon) joins the faculty as Assistant Professor in the fall of 1972. Dr. Strong is presently a postdoctoral fellow at the University of Chicago, and his areas of interest are population biology and ecology.

Melbourne C. Whiteside joined the Department of Zoology and Entomology, University of Tennessee, Knoxville, in January of 1972. Dr. Whiteside, a paleoecologist, was formerly at California State College at Fullerton. His primary interest is the biology of fossil and Recent chydorid cladocerans.

William S. Wooleott of the Department of Biology, University of Richmond, has been appointed Chief Investigator of the Environmental Studies Program at the Virginia Institute of Scientific Research, a research division of the University of Richmond. Dr. Wooleott will be assisted in the program by **John W. Bishop**, Associate Investigator. **Robert F. Smart**, Provost of the University of Richmond and former Head of the Department of Biology, will retire from all duties at the end of spring semester, 1972. Dr. Smart has been with the University since 1929.

Howard J. Arnott has been appointed Professor of Biology and Chairman, Department of Zoology, University of South Florida. Dr. Arnott comes from the University of Texas and has a primary interest in ultrastructure. Additional appointments in the Department include: **Dr. Reed Flickinger**, Professor of Biology, a developmental biologist now at SUNY, Buffalo. **Dr. Charles E. King**, Associate Professor of Biology, a pop-

ulation biologist and geneticist from Yale; **Dr. Gary R. Babbe**, Assistant Professor of Biology, a population geneticist from the University of California at Davis; and **Dr. Stanley Grove**, Visiting Assistant Professor of Biology, a plant physiologist from the University of Texas. **Dr. Arthur C. Mathieson** returns to the University of New Hampshire after spending 1971-72 working with **Dr. Clinton J. Dawes** on a Sea Grant Project involving the biology and ecology of the genus *Eucheuma*. **Dr. Harold J. Humm** continues to direct the Sea Grant Project concerning techniques for the cultivation of the alga, *Eucheuma*.

Eleanor R. Seheer (Ph.D., Rutgers) joined the Department of Biological Sciences, Mississippi State College for Women, in the fall of 1971, following a postdoctoral fellowship in microbiology at Duke University. Her current interest is in staphylococcal bacteriophages. **Crawford G. Jackson, Jr.**, has returned from his visiting appointment at San Diego State during 1970-71.

The Department of Biology, University of South Carolina, announces the following additions: **Dr. Gerald Mizejewski** (research interests in immunobiology and developmental biology); **Dr. Michael Felder** (plant genetics); and **Mrs. Lucrecia Wahl** (auto-tutorial instruction).

Lee H. Pratt and **Frederick T. Wolf** of the Department of General Biology, Vanderbilt University, presented papers at the meeting of the American Society of Plant Physiologists in August of 1971. Dr. Pratt attended an advanced Study Institute on Phytochrome held in Eretria, Greece, where he presided at a paper session and subsequently attended the European Symposium on Phytomorphogenesis.

Richard C. Bruce (Ph.D., Duke) has been appointed Executive Director of the Highlands Biological Station, effective June 1, 1972. Dr. Bruce comes to The Highlands Station from Western Carolina University. His research has dealt primarily with the ecology and life history of salamanders of the Southern Appalachians. The retiring Executive Director, **Dr. Thelma Howell**, has held the post since 1948.

About Institutions

Atlanta University has received a grant of \$17,000 from the Research Corporation for the purchase of a liquid scintillation counter and an ultracentrifuge. **Dr. Joe Johnson** and **Dr. Judith Lumb** are the principal investigators.

The University of Alabama, Tuscaloosa, will have a Short Course for College Teachers and an Institute for College Teachers supported by the National Science Foundation during the summer of 1972. A three-week

course (June 12-30) concerned with Experimental and Environmental Phycology is sponsored by the Botanical Society of America and will be directed by **T. R. Deason**. The Environment and Man Summer Institute will have as Director, **David T. Rogers**. Dates for this summer Institute are June 9 to July 28.

Birmingham-Southern College is the recipient of a Research Corporation Grant of \$4,000 to study the extent of particulate air pollutants plugging stomatal pores. Chief investigators are **Drs. Wall and Quarles** of the Department of Biology.

Florida State University has received a NIH Grant for \$127,000 for the period June 1, 1972 to May 31, 1977. The grant will be used in the study of membrane phenomena and cell compartmentation.

Georgia College, Department of Biology, will expand into a new \$1,200,000 addition to its present facility during the summer of 1972.

Mississippi State University will renovate its Harned Hall facility during the next 8 to 12 months.

The University of Miami's Rosenstiel School of Marine and Atmospheric Science has constructed and equipped a 1.4 million dollar general purpose deep sea oceanographic research vessel with funds provided by the National Science Foundation. The ship, *R/V Columbus Iselin*, was named for the former Director of the Woods Hole Oceanographic Institution. The 170 foot steel-hulled vessel carries a crew of 12 with accommodations for 13 scientific personnel. Scientific expeditions are planned through November 30, 1972 and will include waters off the Cape Verde Islands, the Straits of Florida, and the Gulf of Mexico.

The University of North Carolina at Chapel Hill has established a new degree-granting "Curriculum in Ecology" to produce broadly trained graduates in ecology and environmental science. The interdepartmental effort is comprised of 21 faculty members from 8 different Departments and Institutes. The first students were admitted in the Fall Semester of 1971. Degrees available are the Master of Arts, Master of Science, and Doctor of Philosophy. The Chairman of the "Curriculum in Ecology" is Professor **Alan E. Striven** of the Department of Zoology.

The University of South Carolina has received a NSF grant for the study of shell formation. Principal Investigator is **Dr. Norimitsu Watabe**. The U.S. Department of Education Division has awarded **Dr. David Husband** a grant in support of his research on innovative teaching techniques. The Department of Biology has established a new curriculum in Marine Science at the undergraduate level.

29.06

The ASB

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Launching of the Research Vessel *Columbus Iselin*

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CONTENTS

The Place of Poetry in a Scientific Culture — Perry C. Holt	143
Meritorious Teaching Award for 1972	148
Orland E. White (1885-1972)	149
Twenty-fifth Anniversary of the Gulf Coast Research Laboratory	149
Gant and Clebsch Win Research Award	150
Association Affairs	151
Books and Periodicals	155
News of Biology in the Southeast	155

THE COVER

The University of Miami Research Vessel *Columbus Iselin* was launched in the Interoceanic Waterway at Jacksonville, Florida on March 1, 1972. The completely air conditioned 170-foot vessel was designed by Rudolph Matzer and Associates, Naval Architects and Engineers, built by J. Bellinger Shipyard, Inc., and financed by a \$1.4 million grant from the National Science Foundation. The *Iselin* is designed for a sustained sea speed of 13.5 knots and has an endurance of 35 days carrying 13 scientific personnel and a crew of 12. She has 1075 square feet of laboratory space, and her open main deck provides a 2000 square foot platform for scientific operations and equipment. (Photograph courtesy of Florida Department of Commerce)

The Place of Poetry in a Scientific Culture¹

PERRY C. HOLT²

Department of Zoology, Virginia Polytechnic Institute and State University, Blacksburg

I should like to begin this lay sermon by quoting, a text if you choose, a sonnet written one hundred sixty-five years ago by a poet now much neglected. The poem is Wordsworth's — "The World is too Much With Us."

"The world is too much with us: late and soon
Getting and spending, we lay waste our powers:
Little we see in Nature that is ours;
We have given our hearts away, a sordid boon!

This sea that bares her bosom to the moon;
The winds that will be howling at all hours
And are upgathered now like sleeping flowers;
For this, for everything, we are out of tune;

It moves us not. — Great God! I'd rather be
A Pagan suckled in a creed out worn.
So might I, standing on this pleasant lea,
Have glimpses that would make me less forlorn;
Have sight of Proteus rising from the sea;
Or hear old Triton blow his wreathed horn."

I do not want to recite the litany of doom: the prophets of doom have preached their tenets beyond the point of conviction in recent years, though it might be well for us to remember that Cassandra and Jeremiah were, though unheeded, correct in their foresightful despair. And I must confess to a deep empathy with the greatest of the humanistic biologists of the Victorian Age,

Thomas H. Huxley, when he said "I know of no study which is so saddening as that of the evolution of humanity as it is set forth in the annals of history . . . Man is a brute, only more intelligent than other brutes . . . even the best of modern civilizations appears to me to exhibit a condition of mankind which neither embodies any worthy ideal nor even possesses the merit of stability . . . [I] would welcome a kindly comet to sweep the whole affair away" (Quoted by J. B. Bury, *The Idea of Progress* [MacMillan, 1932]).

And I agree with Max Born completely: "I am haunted by the idea that this civilization, caused by the scientific method, may be irreparable . . . The political and military horrors and the complete breakdown of ethics which I have witnessed during my lifetime may be not symptom, an ephemeral social weakness, but a necessary consequence of the rise of science — which in itself is among the highest intellectual achievements of man . . . This is no prophecy, only a nightmare. Though I have not taken part in applying scientific knowledge to destructive purposes . . . I feel my own responsibility" (*My Life and My Views* [Scribner's, 1968]).

We see on every side the evidences of deterioration, decay and despair in this civilization for which Copernicus, Newton, Darwin, Freud and Einstein laid the foundations and it is time, with this background, that I define my terms, state my themes and attempt my own assessment of where we are and whither we goest.

Poetry, by an extension of meaning that may be the only original thought in this essay (although it is the obvious practice in most, or all primitive religions), includes all man's affective responses. In other words I am simply using the

¹ Revised version of a paper read at the April 7, 1972, meeting of the West Virginia Academy of Science, Bluefield, West Virginia.

² I wish to acknowledge the aid of Dr. Wilson C. Snipes, Head, Department of English, Virginia Polytechnic Institute and State University, who helped me find the source of two quotations. Dr. Charles A. Kennedy, Department of Philosophy and Religion, Virginia Polytechnic Institute and State University, read the manuscript and made helpful suggestions as did several of my colleagues and friends. I am grateful to them.

word as a rubric for all of man's fine arts and emotive responses, including religion — religion as distinct from ethics, for the two are not the same. Religion is composed of man's varied responses to something outside himself that he recognizes as other and greater than himself — uncontrollable by himself. Religion is the feeling of the "spookiness" of existence. The lack of religion is what Wordsworth was deploring in his great sonnet with which we began. If one accepts this equivalence of religion to an emotive response to the great Other or the universe, however you choose to phrase it, it becomes obvious that such responses are a matter of taste, temperament or tradition on the part of an individual or a culture and that there is a relativity of, not valid, but appropriate, religious responses.

Ethics is something else again. The historical fact that all men everywhere, since, at least, the time of our ancestors, Neanderthal man, have been both religious and have lived by a code of ethics almost always, if not entirely, sanctioned by their religion has led to much confusion of thought among our ablest anthropologists and philosophers. There is a relativity of religious response that is as valid as my preference for the music of Bach over that of the Beatles (to use a not too absurd example, for many people of taste and intelligence hold the opposite preference). There is not the same relativity, without getting into a discussion of "situation ethics", in ethical values. Within the tribe or even larger society, certain things are universally held by man to be good, others bad. Which is not to say that there is an exact congruity in the ethical beliefs, that is to say, value judgements, of all peoples at all times. Conditions in different societies in different environments and cultures lend at least this much validity to situation ethics. But the killing of a fellow tribesman or lying to him or stealing from him are, to my knowledge, universally condemned. The Golden Rule, in some form, is almost, if not universally, a tenet of all ethical systems.

That this should be so is involved in the very evolution of man as a psychosocial animal. A consensus is developing among evolutionists that Darwin and T. H. Huxley despaired too soon in their efforts to explain man's ethical beliefs in

evolutionary terms. Without attempting to document this position, I will only say that it is distilled from the writings of George G. Simpson, Sir Julian Huxley, C. H. Waddington and several philosophers, among others, including, perhaps, a mite of my own reflections on man's evolutionary history. The argument, when developed, which I shall not attempt here, is simple: right behavior is that which preserves the cohesiveness and, hence as a social animal, the survival of the tribe without which man cannot exist. Thus defined, there is a naturalistic basis for ethics and the early "imprinting" of these norms of behavior upon the young is what we mean by conscience.

The problem can now be stated. The exponential increase in scientific, that is verifiable, knowledge that has led to a comparable increase in technology has produced at this time in man's history a crisis in which the old values sanctioned by the old religions are inadequate. Technology began when man made his first tool and subsequent advance was thereby inevitable; science began no later than the early seventeenth century with Galileo and Harvey; the contemporaneous marriage of man's childlike urge to know which is pure science and the rather remarkable technology that had developed during the intervening period of one to two million years account for the amazing increase in man's power to exploit and control his environment. Hence, the presently over populated and over exploited planet.

About a hundred years before the union of science and technology, Luther nailed his famous (or infamous, according to your own cultural bias) theses to the cathedral door and the old religious sanctions, which never worked too well anyway, began to fall apart. In any case, man's greed for material goods was now blessed by the so called "Puritan ethic" and from its base in western "civilization," in Europe, the rape of the earth proceeded with truly awe-inspiring rapidity. There is no need here to recite the statistics and the prophecies of the Jeremiah's, or the "eco-nuts," if you prefer. To make money, to achieve economic growth (that is to use all that can be wrested from the earth of non-renewable resources), to increase the population, to get bigger in every way, became not only the official religion of Junior Chambers of Commerce, but of all of

society, sanctioned as it was and is by the Puritan ethic of hard work, thrift, the accumulation of worldly goods.

To repeat, I don't need to document the urgencies of the "crisis of crises" we face. I don't even need to propose the technological remedies. Both are too well known.

What I must do — and if I sound too much like Amos or Micah, please forgive me, but I told you this was a sermon and you should have stopped reading then if you don't want harsh words and dark sayings — is to cry out in the wilderness and try to point out the way; to lay down some necessary conditions we must meet if there is to be any hope of saving the species, not to speak of civilization.

The scientists must come to the market place and accept moral responsibility for the wares they have sold so profitably in recent decades, if for no other reason than that only they can more nearly judge the consequences of their new and hard-earned knowledge. For people like me, whose knowledge of obscure annelid worms is not likely to be other than, at best, an ornament of a healthy society, I must do what I am paid to do, which is to teach, that is, to "tell it like it is, brother" — to show the student youth where the action is. The more technologically trained can help tame the beast of technology by training the youth to not over populate the earth and to preserve her non-renewable treasures. This is not in any way to be taken as anti-intellectual. I must, I have committed myself, plead for more knowledge, for more pure — in all senses of the word — science. But, while pleading for more knowledge, I must point out that knowledge is power and point out *ad nauseum* that we have misused this power.

And now I get to the deep secret of the matter where salvation may just possibly lie: the scientist must not only assume moral responsibility for his discoveries and help determine the ethical standards that can support a viable society, he must help fashion the poetry, the religion, that sanctions those values.

We have at hand, I believe, as I intimated earlier, the empirical bases for scientifically determined values. Though B. F. Skinner and Theodosius Dobzhansky will disagree for the present on some of these, I hope, at least, that

the decision will be in favor of Dobzhansky's bias for freedom. But a sustaining religious viewpoint? Not yet, here is where all the recent writers on these problems have fallen down. I can expect nothing better than some recognition of my courage or sympathy for my foolhardiness in attempting what follows as I too fall on my face.

De Chardin and Sinnott may be commended for their well meant efforts; Lord Russell, nonetheless, was probably more nearly correct when he condemned all religions as the greatest curse to ever befall man. At least as far as any organized religion, as it is now, is concerned, I am forced to agree with him. But Russell, himself, by my standards, was a deeply religious man. Read the essays that won him the Nobel prize in literature and listen as he quotes with approval the Italian Leopardi's poem, translated by R. C. Trevelyan, entitled "The Infinite" (*The Impact of Science on Society* [Simon and Schuster, 1953]):

"Dear to me always was this lonely hill
And this hedge that excludes so large a part
Of the ultimate horizon from my view.
But as I sit and gaze, my thought conceives
Interminable vastnesses of space
Beyond it, and unearthly silences.
And profoundest calm; whereat my heart almost
Becomes dismayed. And as I hear the wind
Blustering through these branches, I find myself
Comparing with this sound that infinite silence;
And then I call to mind eternity.
And the ages that are dead, and this that now
Is living, and the noise of it. And so
In this immensity my thought sinks drowned:
And sweet it seems to shipwreck in this sea."

The writings of Loren Eiseley strike somewhat the same chord. Robert Graves has said that the original religion of the aborigines of the Mediterranean regions who were the ancestors of many of us was the worship of the Great Mother Goddess, the Earth Herself. If true, perhaps our longfathers were wiser than we. My fellow invertebrate zoologist, Joel Hedgpeth, in a lecture entitled "Excalibur Recycled," has gone to the ancient Celt's reverence for nature to make precisely the point that I am trying to make here. My plea against a charge of plagiarism is that in one way or another, I have been saying these things for years before I heard Hedgpeth's lecture

My own preference for a basis for the sanctioning of values that may just hold the species together and pulls us through the greatest "time of troubles," to use Toynbee's phrase, that man has ever known, goes back to a more primitive source. May I quote from Colin Turnbull's *"The Forest People"* [Doubleday and Co., 1962], an account of Turnbull's life with the Pygmies of the Ituri Forest of the Congo? One of the Pygmies, Moke by name, is explaining to Turnbull his people's religion: "The forest is father and mother to us . . . and like a father or mother it gives us everything we need — food, clothing, shelter, warmth . . . and affection. Normally everything goes well, because the forest is good to its children, but when things go wrong there must be a reason' . . . He told me how all Pygmies have different names for their God, but how they all know that it is really the same one. Just what it is, of course, they don't know, and that is why the name really does not matter very much. 'How can we know?' he asked. 'We can't see him . . . But he must be good to give us so many things. He must be of the forest. So when we sing, we sing to the forest . . .' Of the disaster that has befallen them they sing this one great song: 'There is darkness all around us; but if darkness is, and the darkness is of the forest, then the darkness must be good?'"

There is much in existing religions that could be incorporated into one that regards the good earth as sacred, or rather many existing religions contain elements that, if given proper emphasis, would support an ethos that would enable us to preserve our environment and the race itself. We hear Lynn White's call for Saint Francis as the patron saint of ecologists, many modern Christian churchmen are as concerned as we about the ecological crisis (that is, over-population and over-exploitation of non-renewable resources) and to my knowledge there is nothing in Hinduism or Buddhism that contradicts my thesis (Islam is a religion of the "Book" and does not vary, in this regard, very much from the Judeo-Christian tradition). But the problem is that all these religions are deeply committed by tradition to supernatural entities and credal elements that many men of today and most who are scientists find it difficult or impossible to accept.

Somehow, it seems to me, there is laid upon the scientists and scholars the duty of Jonah to continue these pleas, each in his own way, for a poetie, that is a reverent, regard for the good earth that supports us. And each in his own way (and for many this can be an application of their technical knowledge and skills to the solution of ecological problems) can try to influence others, to warn of the dangers, to offer his help in solving individual problems.

Some will attack me for coming down from Academia's sweet secluded towers, for urging upon you activities traditionally reserved for others — politicians for example. I would reply, that on the contrary, it is precisely the duty of the academies to set the intellectual tone of the times, to help determine the ideas, the high ideals, that men live by.

Some will have noted that I have not mentioned pollution. In a stable population that the world can support without the irretrievable exhaustion of non-renewable resources, we have already at hand the means of preventing pollution. And, if my thesis that the Earth is our sacred Mother is correct, who could be so sacrilegious as to befoul Her?

It is my contention, then, that only a worldwide acceptance of the view of the Pygmies that "the forest [the earth as a whole] is father and mother to us and "like a father or mother gives us everything we need — food, clothing, shelter, warmth and affection" will prevent ultimate, and not too long delayed, catastrophe. That this means a radical change of our religious, economic and political beliefs and a worldwide society and a worldwide government, bothers me not at all. The alternative is literally, grimly, the death of civilization and the species.

So what are the chances? Cassandra was ignored and Troy fell; Jeremiah was ignored and Judea was driven into captivity. I, personally, have no hope — it is too late and the self-sustaining drive of man towards more and more growth in everything is probably incapable of being stopped and Wordsworth's sad cry will go unheeded.

So why worry? The vast majority of species that have lived on the earth have long since passed, never to return, and I cannot believe that

man is an exception. Reverence for Mother Earth can at best only postpone our ultimate and final return, as a species, to her soil and rocks and the larger universe will neither note nor regret our passing.

To recapitulate: if there is any hope that man can run his course until some non-manmade catastrophe overwhelms him, we must apply technical solutions that include a reduction of man's standards of living and his numbers to the point at which civilizations and societies depend entirely upon renewable resources. The only hope of doing this is the acceptance, with ardor, by most men everywhere, of a world-wide religious reverence for all life and the *Earth that sustains* us. If this solution fails, and my personal feeling is that it will, then there is still in poetry — religion, if you wish — some solace. Houseman's "*Shropshire Lad*" can serve:

"Therefore, since the world has still
Much good, but much less good than ill,
And while the sun and moon endure
Luck's a chance, but trouble's sure
I'd face it as a wise man would,
And train for ill and not for good.
'Tis true the stuff I bring for sale
Is not so brisk a brew as ale:
Out of a stem that scored the hand
I wrung it in a weary land.
But take it: if the smack is sour,
The better for the embittered hour;
It should do good to heart and head
When your soul is in my soul's stead;
And I will friend you if I may,
In the dark and cloudy day."

For ill or good, the practice of science has given us a measure of foresight. We can strive to avoid the evil end as long as we can, for we are men and, therefore, we must, but when the end is inevitable, again Houseman has something to say:

"Up, lad when the journey's over
There'll be time enough to sleep.

And

"I shall have lived a little while
Before I die forever."

Finally, from Houseman, yet:

"Therefore, though the best is bad,
Stand up and do the best, my lad
Stand up and fight and see your slain
And take the bullet in your brain."

To me our choice is clear: as long as we can we must live and reverence and care for life. And then, from our own egocentric viewpoint, as the dominant form of life Mother Earth has produced, when the end is inevitable, we can say with e. e. cummings (*I x I* [Henry Holt, 1944]):

"What if a much of a which of a wind
gives the truth to summer's lie;
bloodies with dizzying leaves the sun
and yanks immortal suns awry?
Blow king to beggar and queen to seem
(blow friend to fiend: blow space to time)
—when skies are hanged and oceans drowned,
the single secret will still be man.

What if a dawn of a doom of a dream
bites this universe in two;
peels forever out of his grave
and sprinkles nowhere with me and you?
Blow soon to never and never to twice
(blow life to isn't; blow death to was)
—all nothing's only our hugest home;
the most who die, the more we live."

My final personal reaction (I have been ruined by civilization and am not Moke) will be Dylan Thomas's (*The Collected Poems of Dylan Thomas* [New Directions, 1953])

"Do not go gentle into that good night.
Rage, rage against the dying of the light."

Though there may be no hope, despair is not yet and not for men. Unless you are craven, you will go out and preach and practice the gospel according to Wordsworth and Moke.

Meritorious Teaching Award for 1972

Dr. Aaron J. Sharp, Alumni Distinguished Service Professor of Botany at the University of Tennessee, was selected to receive the Meritorious Teaching Award at the annual meeting of the Association of Southeastern Biologists in Mobile. This award, sponsored by the Association, is presented each year to a member who has made a distinguished contribution to teaching of biology in the Southeast.¹

Dr. Sharp is an authority on mosses, and has conducted research in the United States, including extensive studies in the Great Smoky Mountains National Park; Mexico; Guatemala; and in the Far East and Asian countries. His summer field trips to Mexico, in which many generations of graduate students have participated, have become one of the legends of graduate education in the Southeast.

In 1964-65 Dr. Sharp's research took him to the Hattori Botanical Laboratory in Nichinan, Japan, under auspices of the National Science Foundation. While in the Far East he conducted field studies in India and the Philippine Islands. In 1968 he made botanical studies in the Aleutians Islands, and also in the Mt. Kilimanjaro region of Tanzania, Africa.

Dr. Sharp received the B.S. degree in botany from Ohio Wesleyan University in 1927; the M.S. in botany from the University of Oklahoma in 1929; and the Ph.D. in botany from Ohio State University in 1938. Ohio Wesleyan awarded him an honorary D.Sc. in 1952.

After two years of teaching at the University of Oklahoma, he joined the University of Tennessee faculty as instructor in botany in 1929. He became a professor in 1940, and was head of the Department of Botany from 1951-1961, when he relinquished the headship in order to devote full time to teaching and research. He was curator of the University of Tennessee herbarium from 1958-1968.

On various occasions he has served as visiting professor at other institutions including West Virginia University, Stanford University, the University of Michigan Biological Station, the National Taiwan University, and the University of Minnesota Biological Station.

He was president of the Botanical Society of America in 1965, has served as president or vice president of numerous other scientific organizations. These include the American Society of Plant Taxonomists (president, 1961); the Ecological Society of America (vice president, 1959);

¹ We have just learned that Dr. Sharp also received a Merit Award from the Botanical Society of America at their Annual Banquet, August 26, 1972 in Minneapolis. —Ed.



the Association of Southeastern Biologists (vice president, 1955); Tennessee Academy of Science (president, 1953); Southern Appalachian Botanical Club (president, 1947); American Bryological Society (president, 1935); and American Association for the Advancement of Science (sectional vice president, 1963).

Dr. Sharp has served in editorial capacities on several scientific publications, including the *American Journal of Botany*. His published scientific articles and books number more than 180.

He holds or has held membership in 37 professional and learned societies. In recognition of his contributions to science and to the University of Tennessee, his colleagues elected Dr. Sharp to deliver the annual Phi Kappa Phi Faculty Lecture at the University of Tennessee the spring of 1966.

Among all of his many accomplishments and honors, his long-standing reputation as an outstanding teacher is attested by many generations of graduate and undergraduate botany students. As he received the congratulations of his colleagues for the Meritorious Teaching Award, he was heard to remark repeatedly, "But I have enjoyed teaching."

ORLAND E. WHITE

(April 25, 1885 — January 10, 1972)

Dr. Orland Emile White, Emeritus Professor of Biology at the University of Virginia, first Director of the University's Blandy Experimental Farm, and winner of the ASB Meritorious Teaching Award in 1953, died in Charlottesville January 10, 1972. Dr. White was born in a sod house at Sibley, Iowa, the son of Henry Clay and Margaret Rush White, and grew up in South Dakota. He credited his mother with fostering his early interest in plants and gardening. As a student at the South Dakota State College of Agriculture and Mechanics at Brookings he assisted Dr. Niels E. Hansen in his efforts designed to breed hardy fruits and agricultural crops for the northwest plains. It was there that he first came under the influence of botanist E. W. Olive; first read Gregor Mendel's paper on inheritance in peas; and first met Loto Underwood, who was to become his devoted wife and companion in his world travels in search of new and interesting plants.

Perceiving that plant breeding would henceforth require a foundation in genetics as well as botany, he went to the Bussey Institution at Harvard University to work under Professor E. M. East. He received an M.S. in Botany, and an M.S. in Genetics from Harvard, and finally the D.Sc. degree in 1913. From 1913 to 1927 Dr. White was in charge of plant breeding and economic plants at the Brooklyn Botanical Garden. During World War I he was the civilian director of a castor bean production program for the United States Government aimed at producing castor oil for the lubrication of aircraft engines. In 1921-22 he was botanist on a scientific expedition which crossed the Andes and proceeded down the Amazon River Valley, a tragicomic adventure about which he loved to reminisce.

In 1927 Dr. White came to the University of Virginia as Director of the newly established Blandy Experimental Farm in Clarke County, Virginia, in the Shenandoah

Valley. Here he established a research and educational program that soon enjoyed a world-wide reputation and attracted able students of botany and plant genetics, many of whom subsequently made outstanding contributions to plant breeding, biological research, and teaching at many institutions all over the United States, Canada, and elsewhere. His own research interests revolved around the genetic basis of economic characteristics such as winter hardiness and fasciation, but he encouraged his students to follow wherever their research problems led, and the training they received during their spring and summer terms of research at Blandy Farm and their fall and winter terms taking courses at the University in Charlottesville was broad enough to permit them to choose a wide variety of paths after they received their degrees.

Dr. White always thought of himself as a geneticist, but his deep love of plants, especially economic plants, led him to develop an outstanding collection of woody plants at Blandy Farm. Upon his retirement in 1955 the Board of Visitors ordered that the 100 acre arboretum be named the Orland E. White Arboretum in his honor. Among the fine collections that remain as a memorial to his wide travels in search of interesting materials and artistic eye for landscape effects are one of the finest collections of pines in the world, a unique grove of ginkgo trees, a boxwood collection, and many other rare and unusual specimens.

Dr. White's last contribution to botanical literature appeared in *The American Horticultural Magazine* in 1971. On the back cover of the magazine, to illustrate the memoir of his plant-hunting travels, is a colored picture he took of Mrs. White standing under an enormous specimen of the outlandish Bromeliad *Puya raimondii* growing on a granite mountain quarry high in the Andes. It represents, to the many students whose growth and development he fostered in his unique way, a fitting memorial to two life-long romances.

— MARGARET Y. MENZEL

Twenty-fifth Anniversary of the Gulf Coast Research Laboratory

The Mississippi Academy of Science, at its spring meeting at Millsaps College in Jackson in April 1972 marked the twenty-fifth anniversary of the Gulf Coast Research Laboratory at Ocean Springs with a simple ceremony. Certificates of appreciation were issued to early workers at the Laboratory.

The Laboratory was formally founded and established by the Academy at its spring meeting in Biloxi in April 1947. Summer teaching was carried on that year by members of the Academy. Dr. Richard L. Caylor of Delta State College was

a prime mover in the establishment of the Laboratory and was the director of the summer sessions which were held in Magnolia State Park and later at the present site. A year around operation began when Dr. Aubrey E. Hopkins became director in 1952. When he died in 1955 Doctor Caylor became interim director until Dr. Gordon Gunter took over in September of that year.

So the Laboratory had three directors in the first eight years of its existence and Dr. Gunter, the surviving member of these early directors, was presented a certificate of esteem by Dr. Harold D. Howse.

Doctor Gunter then gave certificates to all of the earlier members of the teaching staff and the two former directors, or their survivors. His remarks are given below:

"I think that you well understand that the Gulf Coast Research Laboratory was conceived by its founders when the population, the economic beat of the country, and the general tenor of our ways was slower and less. Early visitors to the coast came in Model A Fords on old gravel roads, and I have said before that Dr. R. L. Caylor had qualifications that would have made him a good forage master in the Confederate Army. Even in my time I have seen one field trip group where people got long-faced because the trawl catches came up light, and they perforce looked forward to short rations. But this group was so good and well-intentioned that we made a special dispensation which excused it from the fifty cents a night dormitory fee that was charged for those old wooden dormitories in those days. I might add that the men were all exuberant, and they would pile out of bed at the break of dawn and holler as countrymen were wont to do years ago. This disturbed people for a remarkable distance about, and I stopped it. But I have always regretted that action because I never heard a man holler at dawn since then, and now it is only a happy memory of my childhood and the late Honorable A. L. (Pop) McGaugh.

"It goes without saying that very few things were plush and shiny at the Laboratory in those early days, which really was before my time, but I went by there, and I remember what a lush, dank seaside it was, where the people worked on rough, wooden tables under the trees. I wish that it could become so pretty again, but Hurricane Camille and the progressive hand of man, including in part yr. obd't. sv't., has struck the place a mortal blow from which we, at least, shall not see it recover.

"Back in those early days the students as well as the staff put up with a lot of inconveniences, but they were dedicated and gave their efforts with fortitude and deep hope for the future, and certainly not for money. I know of no specific instance, but I feel quite sure that the very earliest teachers sometimes taught for nothing or for less than it cost them to go and come from their permanent abode. I do know that one man told me that he taught there for \$10 a week.

"So from 1947 to 1954 inclusive, summer courses were taught at the Gulf Coast Research

Laboratory for college credit by people who were buoyed up by good will, hope, and a general regard for mankind and the State of Mississippi, without which the institution never would have survived its establishment by this Academy . . .

"It is in honor of these fine people that we are holding this little ceremony. And so, without further ado, let me say that it is with pride and affection that certificates of esteem are being presented here to help mark the Twenty-fifth Anniversary of the Gulf Coast Research Laboratory. These go to the conscientious people who gave of their time and knowledge to the college students who came to learn about the marine sciences during the early years. . . ."

Those recognized included Ellinor H. Behre, R. B. Channel, Delzie Demaree, J. M. Frazier, H. M. Hefley, Ira D. Hogg, Harold Humm, H. J. Jacob, T. W. Johnson, Y. J. McGaha, Cecil P. Marion, David Paneratz, R. R. Priddy, J. D. Ray, J. C. Rice, J. H. Roberts, Eloise Rowland, R. Schuster, H. H. Shoemaker, F. A. Varrelman, W. E. Wade, J. F. Walker, S. L. Wallace, and J. A. Ward, as well as eight who are now deceased (P. T. Brown, R. L. Caylor, Paul Dunn, J. F. Howell, A. E. Hopkins, J. G. Jacob, B. N. Kaufman, J. B. Price).

GANT AND CLEBSCH WIN RESEARCH AWARD

Winners of the Association of Southeastern Biologists' Research Award for 1972 were Robert E. Gant and Edward E. C. Clebsch, for their paper entitled "*The Allelopathic Influence of *Sassafras albidum* on Old Field Succession*" (Abstract No. 301). Mr. Gant is a graduate student and Dr. Clebsch is a professor in the Department of Botany, University of Tennessee.

DUES BARGAIN

The Botanical Society of America is offering to all *new members* who join before January 1, 1973, a 50% reduction in dues for 1973: \$3.00 for undergraduate and graduate students; \$5.00 for regular, and \$6.00 for family members; including subscriptions to the *American Journal of Botany* and the *Plant Sciences Bulletin*. Details and application forms may be obtained from the treasurer: Dr. C. Ritchie Bell, Department of Botany, University of North Carolina, Chapel Hill, North Carolina 27514.

ASSOCIATION AFFAIRS

NOTES FROM THE MOBILE MEETING

At the April 1972 Annual Business Meeting of the Association of Southeastern Biologists at the Educational and Research Center of the University of South Alabama at Mobile, Secretary Margaret Gilbert reported a total of 1574 members in all categories.

Acting on recommendations from the Executive Committee, the Association changed the term of office of the Treasurer to coincide with the calendar year, in order to facilitate compliance with Internal Revenue Service requirements. Article II, Section 5, of the Bylaws now reads:

Newly elected officers shall assume the duties of their offices at the close of the annual meeting in which they were elected, except the Treasurer, who shall assume his duties on 1 January of the following year.

Following a report from the Treasurer that expenses exceeded income by \$2200 in the past year, members voted to raise the annual dues. Article IV, Section 1, of the Bylaws now reads:

The annual dues of the Association for Active Members shall be four dollars (\$4.00) for graduate students, eight dollars (\$8.00) for regular members, ten dollars (\$10.00) for contributing members and twenty-five dollars (\$25.00) for sustaining members. Emeritus members shall be exempt from dues.

PLACE AND TIME OF FUTURE MEETINGS

- | | | |
|------|-------------|---|
| 1973 | 12-14 April | Western Kentucky University, Bowling Green |
| 1974 | 18-20 April | Georgia Southern College, Savannah |
| 1975 | 17-19 April | Virginia Polytechnic Institute and State University, Blacksburg |

The 1972 Interim Executive Committee Meeting will be held October 14, Air Host Inn, in Atlanta, Georgia.

OFFICERS, EXECUTIVE COMMITTEE AND OFFICIAL REPRESENTATIVES

1972 - 73

PRESIDENT — Leland Shanor, University of Florida, Gainesville, Florida 32601

PRESIDENT ELECT — David J. Cotter, Georgia College, Milledgeville, Georgia 31601

VICE PRESIDENT — John D. Withers, AIBS, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016

PAST PRESIDENTS —

1971-72 — Grover C. Miller, North Carolina State University, Raleigh, North Carolina 27607

1970-71 — C. W. Hart, Jr., Philadelphia Academy of Natural Sciences, Philadelphia, Pennsylvania 19103

SECRETARY (1970-73) — Margaret L. Gilbert, Florida Southern College, Lakeland, Florida 33802

TREASURER (1971-74) — Raymond O. Flagg, Carolina Biological Supply Company, Burlington, North Carolina 27215

EDITOR — Margaret Y. Menzel, Florida State University, Tallahassee, Florida 32306

ARCHIVIST — Madeline P. Burbanck, Box 15134, Emory University, Atlanta, Georgia 30333

PARLIAMENTARIAN — John M. Rawls, University of South Alabama, Mobile, Alabama 36608

EXECUTIVE COMMITTEE MEMBERS-AT-LARGE:

1973 James N. Dent, University of Virginia, Charlottesville, Virginia 22903

Richard E. Garth, University of Tennessee, Chattanooga, Tennessee 37401

1974 Arthur W. Cooper, North Carolina State University, Raleigh, North Carolina 27607

Joseph F. Fitzpatrick, Jr., Randolph-Macon Woman's College, Lynchburg, Virginia 24504

1975 Edward E. C. Clebsch, University of Tennessee, Knoxville, Tennessee 37916

John M. Rawls, University of South Alabama, Mobile, Alabama 36608

AAAS REPRESENTATIVES:

John D. Withers (1973), AIBS, 3900 Wisconsin Avenue, N.W., Washington, D. C. 20016

Charles L. DePoe (1975), Northeast Louisiana State College, Monroe, Louisiana 71201

AIBS REPRESENTATIVE:

Franklin F. Flint (1973), Randolph-Macon Woman's College, Lynchburg, Virginia 24504

ASB COMMITTEES 1972 - 73

(Dates in parentheses indicated years appointments terminate.)

Research Award Committee:

- CHAIRMAN: Joseph C. O'Kelley (1973), University of Alabama, University, Alabama 35486
Richard E. Garth (1974), University of Tennessee, Chattanooga, Tennessee 37401
Frank O. Perkins (1975), Virginia Institute of Marine Science, Gloucester, Virginia 23062

Meritorious Teaching Award Committee:

- CHAIRMAN: Stuart S. Bamforth (1973), Newcomb College, Tulane University, New Orleans, Louisiana 70118
Robert T. Brumfield (1974), Longwood College, Farmville, Virginia 23901
John M. Herr, Jr. (1975), University of South Carolina, Columbia, South Carolina 29208

Travel Award Committee:

- CHAIRMAN: Clarence E. Styron, Jr. (1973), St. Andrews College, Laurinburg, North Carolina 28352
Beryl C. Franklin (1974), Louisiana State College, Monroe, Louisiana 71201
Jerry M. Baskin (1975), University of Kentucky, Lexington, Kentucky 40506

Place of Meeting Committee:

- CHAIRMAN: Rudolph Prins (1973), Western Kentucky University, Bowling Green, Kentucky 42101
Gerald W. Esch (1974), Wake Forest University, Winston-Salem, North Carolina 27109
John H. Mullahy (1975), Loyola University, New Orleans, Louisiana 70119

Conservation Committee:

- CHAIRMAN: Charles H. Wharton (1973), Georgia State University, Atlanta, Georgia 30322
Arthur W. Cooper (1974), North Carolina State University, Raleigh, North Carolina 27607
Ralph W. Yerger (1975), Florida State University, Tallahassee, Florida 32306

Resolutions Committee (1973):

- CHAIRMAN: Grover C. Miller, North Carolina State University, Raleigh, North Carolina 27607
Gary E. Dillard, Western Kentucky University, Bowling Green, Kentucky 42102
Joseph F. Fitzpatrick, Jr., Randolph-Macon Woman's College, Lynchburg, Virginia 24501

Auditing Committee (1973):

- CHAIRMAN: C. Ritchie Bell, University of North Carolina, Chapel Hill, North Carolina 27514
John N. Couch, University of North Carolina, Chapel Hill, North Carolina 27514
Albert E. Radford, University of North Carolina, Chapel Hill, North Carolina 27514

Nominating Committee (1973):

- CHAIRMAN: C. W. Hart, Jr., Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania 19103

Elsie Quarterman, Vanderbilt University, Nashville, Tennessee 37203

Walter S. Flory, Wake Forest University, Winston-Salem, North Carolina 27587

Constitution and Bylaws Committee (1973):

- CHAIRMAN: Perry C. Holt, Virginia Polytechnic Institute, Blacksburg, Virginia 24061
Robert B. Short, Florida State University, Tallahassee, Florida 32306
George C. Kent, Jr., Louisiana State University, Baton Rouge, Louisiana 70803
Madeline P. Burbanck, Archivist, *ex officio*, Box 15134, Emory University, Atlanta, Georgia 30333

Margaret L. Gilbert, Secretary, *ex officio*, Florida Southern College, Lakeland, Florida 33802

ASB-AIBS Relationship Committee (1973):

- CHAIRMAN: David J. Cotter, Georgia College, Milledgeville, Georgia 31601
Franklin F. Flint, Randolph-Macon Woman's College, Lynchburg, Virginia 24504
James Stidham, Presbyterian College, Clinton, South Carolina 29325

Local Arrangements and Program Committee:

- 1973 — Western Kentucky University, Bowling Green, Kentucky 42101
Gary Dillard
Rudolph Prins
1974 — Georgia Southern College, Statesboro, Georgia 30458
Edwin T. Hibbs

Past President's Council:

- CHAIRMAN (1973): Grover C. Miller, North Carolina State University, Raleigh, North Carolina 27607

TRAVEL AWARDS FOR GRADUATE STUDENTS

For the sixteenth year there will be funds available for assistance to graduate students for expenses in connection with the annual ASB meetings to be held in 1973 at Western Kentucky University, Bowling Green, Kentucky. At least \$300 will be available, and it is anticipated that most of the awards will be for maintenance (lodging and meals). Departments are urged to provide travel allowances for their graduate students or to invite them to travel in cars with staff members. Some travel allowances may be awarded by the committee to those living most distant from Bowling Green.

Any graduate student needing financial assistance in order to attend the 1973 meeting of the ASB is eligible. Rules for making application for the awards are as follows:

1. Indicate if application is being made for maintenance or travel or both. Give details, such as total sum requested, how many nights and days are involved, if travel allowance is requested, the number of miles involved and the proposed method of transportation, and any other pertinent information.
2. Give information as to whether or not a paper is being presented by the applicant.
3. In a paragraph, give a brief history of your education to date, of how many years you have been — and plan to be — in graduate school, of your major field or fields of interest, of any publications which have appeared or which may be in preparation, and any other pertinent professional details. Give information on marital status and number of children.
4. Give your source or sources of support while in graduate school such as G.I. Bill, N.S.F., N.I.H., teaching assistantship, etc.
5. Have your major professor or departmental head write a letter supporting your application.
6. Applications and supporting letters, both in triplicate, should be in the hands of *Dr. Clarence E. Styron, Jr., St. Andrews College, Laurinburg, North Carolina, 28352*, by 1 February, 1973. Applicants will be notified of the decision of the Committee as soon as possible.

JERRY M. BASKIN
 BERYL C. FRANKLIN
 CLARENCE E. STYRON, *Chairman*

ASSOCIATION RESEARCH PRIZE

If you intend to present a paper at the annual meeting of the Association of Southeastern Biologists, we wish to call your attention to the Association Research Prize and invite you to submit your manuscript in competition. This prize is sponsored by the Carolina Biological Supply Company, Burlington, North Carolina. Rules and regulations are as follows:

1. The Research Prize is to be awarded for an especially meritorious paper actually presented at the annual meeting.
2. Only members are eligible to submit papers in competition for the Research Prize. This applies to all names on the submitted paper.
3. Papers submitted in competition may be in press but must not have been published prior to March 1 of the year of the current competition.
4. Papers submitted in competition are judged by eminent scientists in the various fields of

biology. These individuals are selected by the Research Committee and are from schools outside the Southeast. Every effort is made by the Research Committee to keep the authors of submitted papers anonymous. Criteria for the award are left to the discretion of the judges' panel, who may withhold said award if no paper is considered to have sufficient merit.

5. Papers must be submitted in triplicate and in their entirety not later than February 1, 1973, to *Dr. Joseph C. O'Kelley, University of Alabama, University, Alabama, 35486*. One copy of the prize-winning paper will remain in the ASB files, but all other copies will be returned to the authors as soon as possible.

6. Announcement of the winner of the Research Prize will be made at the annual meeting.

FRANK O. PERKINS
 RICHARD E. GARTH
 JOSEPH C. O'KELLEY, *Chairman*

MERITORIOUS AWARD NOMINATIONS

For the twenty-third time, an ASB member will be recognized for especially meritorious teaching at the April, 1973, annual meeting. The Meritorious Award for Teaching is sponsored by Scientific Products, Chamblee, Georgia. The regulations governing the award are as follows:

The recipient must be a member of the ASB in good standing. He should have taught biology in a southern institution for at least ten years, and must be currently teaching. He must not be a dean or have regular administrative duties beyond the department level (this particular criterion requiring interpretation in individual cases). Among evidences of his qualifications is the progress of the candidate as indicated by recognition in his own institution (important assignments and other contributions specifically related to good teaching); and the number and quality of students for whom he provided primarily the inspiration to continue in biology, especially those who later received advanced degrees.

Past recipients of the Meritorious Award for Teaching are as follows:

- 1952. Dr. Mary Stuart MacDougall (Agnes Scott)
- 1953. Dr. Orland E. White (Univ. of Virginia)
- 1954. Dr. Woolford B. Baker (Emory)
- 1955. Dr. John N. Couch (Univ. of North Carolina)
- 1956. Dr. Hugo L. Blomquist (Duke)
- 1957. Dr. Ezda Deviney (Florida State)
- 1958. Dr. Henry R. Totten (Univ. of North Carolina)
- 1959. Dr. Margaret Hess (Winthrop College)
- 1960. Dr. Ora C. Bradbury (Wake Forest College)
- 1961. Dr. Warren Deacon (Vanderbilt)
- 1962. Dr. Septima C. Smith (Univ. of Alabama)
- 1963. Father Patrick H. Yancey (Spring Hill College)

1964. Dr. Ruskin S. Freer (Lynchburg College)
 1965. Dr. Harwell P. Sturdivant (Western Maryland College)
 1966. Dr. Charles Ray, Jr. (Emory Univ.)
 1967. Dr. H. J. Oosting (Duke University)
 1968. Dr. Wade T. Batson (Univ. of South Carolina)
 1969. Dr. William L. Mengebier (Bridgewater College)
 1970. Dr. Elton C. Cocke (Wake Forest University)
 1971. Dr. Earl L. Core (Univ. of West Virginia)
 1972. Dr. A. J. Sharpe (University of Tennessee)

Members are urged to nominate outstanding teachers for this award. Nominations are kept on file from year to year, and those who do not receive the award when they are first nominated are reconsidered by the Committee in subsequent years. Nominations and supporting documentation should be sent to *Dr. Stuart S. Bamforth, Newcomb College, Tulane University, New Orleans, Louisiana, 70118.*

JOHN M. HERR, JR.
 ROBERT T. BRUMFIELD
 STUART S. BAMFORTH, *Chairman*

IVEY F. LEWIS FELLOWSHIP AT MOUNTAIN LAKE BIOLOGICAL STATION

A Research Fellowship of \$150 for summer course study at Mountain Lake Biological Station of the University of Virginia has been continued through the generosity of the Phipps and Bird Company. Any member of the ASB may submit an application. The application should be accompanied by a summary of the planned work, by a list of major publications, and especially in the case of younger workers, by references and educational data. Applications should be addressed to *The Director, Mountain Lake Biological Station, Department of Biology, University of Virginia, Charlottesville, Virginia, 22903.* They should be in the hands of the Director not later than 1 April, 1973. Announcement of the recipient will be made at the Annual Meeting of the ASB.

SUGGESTED NOMINEES FOR ASB OFFICES AND EXECUTIVE COMMITTEE POSITIONS

To the members of the Nominating Committee:

I wish to suggest that you consider the following ASB members in selecting nominees for offices and executive committee positions:

PRESIDENT-ELECT

VICE-PRESIDENT

SECRETARY

EXECUTIVE COMMITTEE MEMBERS (2 for 3-year terms)

Deadline: December 1, 1972

Mail to: *C. W. Hart, Jr., Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania 19103.*

ELSIE QUARTERMAN
 WALTER S. FLORY
 C. W. HART, JR., *Chairman*

Books and Periodicals

PRINCIPLES OF ANIMAL PHYSIOLOGY. Dennis W. Wood. 332 pp. American Elsevier Publishing Co., New York. October 1970. \$11.00.

This is an excellent introductory textbook for animal physiology with particular emphasis on concepts that generally cause difficulty for students. The author has been highly selective in the examples used to illustrate the principles he has included. There is a good coverage of the traditional fields of animal physiology as well as modern developments in methodology. The artificial distinction between general and comparative physiology has not been followed because the author analyzes physiological processes in terms of individual reactions which are then integrated into the more complete processes of living. This is done by treating organismic detection of varying environmental character-

istics, organismic reactions to these changes and the appropriate responses necessary for survival.

Although the major emphasis is on tissue, organ, and organ system physiology, there is an incorporation of the necessary chemical and physical phenomena at the cellular and subcellular levels to give a comprehensive overview of physiology. The application of thermodynamics to biological systems and "retrospect: Homeostasis" are both well written in a manner easily understood by beginning students of physiology. This book will be an excellent text for the course in introductory animal physiology and as a reference for the biology major including those students going into teaching at the secondary level.—J. F. DIMMICK, *Department of Biology, Wake Forest University, Winston-Salem, N.C. 27109.*

News of Biology in the Southeast

STATE CORRESPONDENTS

Alabama — James Wilkes, Troy State Univ.
Florida — Position vacant
Georgia — Fred K. Parrish, Georgia State University
Kentucky — Gary E. Dillard, Western Kentucky University
Louisiana — Harry J. Bennett, Louisiana State University

Mississippi — Crawford G. Jackson, Jr., Mississippi State College for Women
North Carolina — Position vacant
South Carolina — G. Thomas Riggan, Jr., Newberry College
Tennessee — Position vacant
Virginia — Jean Pugh, Christopher Newport College

West Virginia — Position vacant

Crawford G. Jackson, Jr. — Editor
Department of Biological Sciences
Mississippi State College for Women
Columbus, Mississippi 39701

About People

New staff additions to the Department of Biology, George Mason University, Fairfax, Virginia are: **Carl Ernst**, Associate Professor; **Frederick Hinton**, **Larry Frye**, **Judith Skog**, **Norman Sinclair**, and **John Wilson**, all with the rank of Assistant Professor.

David C. White has accepted an appointment as Clinical Scientist at Florida State University, Tallahassee, to begin December 1972. Dr. White is presently a Professor at the Albert Chandler Medical Center, University of Kentucky. **Marc Freeman** joins the FSU staff as Assistant Professor. Dr. Freeman was a Research Associate in the Department of Physiology at Emory University prior to this appointment.

Promotions at the University of Florida, Gainesville, include the following: **William S. Carr** and **Jonathan Reiskind** to Associate Professor of Zoology; **Frank J. S. Maturo** to Professor of Biological Sciences and Zoology; **David Anthony** to Professor of Botany; **Dona Griffin** to Associate Professor of Botany; **Edward Hoffman** to Associate Professor of Microbiology. Dr. **H. K. Wallace**, Professor of Zoology, and Dr. **Albert M. Laessle**, Associate Professor of Zoology, have retired from the University of Florida.

Thomas G. Woleott and **George G. Shaw** have been appointed Assistant Professor of Zoology at North Carolina State University, Raleigh. Dr. Woleott received his Ph.D. from the University of California with special interest in marine science; Dr. Shaw received his Ph.D. in Zoology (soils) from Cornell University with a special interest in ecology. Dr. **H. T. Scofield** has retired from the Department of Botany.

John C. Briggs, Professor of Biology at the University of South Florida, has been appointed Director of Graduate Studies for that institution.

Burton J. Bogitsch has been appointed Chairman of the Department of General Biology at Vanderbilt University. He replaces **R. B. Channell** who will now devote full time to teaching and research.

New appointments in the Department of Biology, Virginia Polytechnic Institute include: **Charles C. Rutherford** (Ph.D., University of Miami, developmental biology), Assistant Professor of Zoology, formerly of Boston Biomedical Research Institute; **Robert Bates** (Ph.D., Colorado State University, virology), Assistant Professor

of Microbiology; **Giles Waines** (Ph.D., University of California, Riverside, plant cytogenetics), Assistant Professor of Botany, formerly of the Botany School, Oxford, England; **Brian Davis** (Ph.D., University of Washington, *Drosophila* cytogenetics), Assistant Professor of Zoology, from the University of California, San Diego; **Curtis Adkisson** (ornithology), Assistant Professor of Zoology, formerly of the University of Michigan; and **Roger Kaesler** (biometry and micropaleontology), Visiting Professor for one year from the Department of Geology, University of Kansas.

Norman B. Marshall, Senior Principal Scientific Officer in the Department of Zoology at the British Museum (Natural History) has been awarded the Rosenstiel Award for Distinguished Contributions to Marine Science. This annual award, a gold medal and prize of \$5,000, is awarded by Mr. Lewis Rosenstiel, for whom the University of Miami School of Marine and Atmospheric Science is named.

Armando de la Cruz, Department of Zoology, Mississippi State University, has been awarded a NSF grant to study the production and flux of organic detritus in a salt marsh estuary.

About Institutions

The **Mote Marine Laboratory**, Sarasota, Florida and the **Marine Science Institute** of the University of South Florida, St. Petersburg, have established a broad-base cooperative program of research on the "red tide." The Mote Laboratory has received a grant of \$50,000 from the Selby Foundation in support of this program; additional funds are also being sought. Principal investigators are **Dr. David Baldrige** of the Mote Laboratory and **Dr. Dean F. Martin** of the Department of Chemistry and Marine Science Institute, University of South Florida.

The Department of Botany, **North Carolina State University**, is establishing a cell and tissue culture laboratory with funds from the Agricultural Experiment Station. The lab is to be headed by **Dr. Ralph L. Mott**. Additionally, they have received an Air Conservation Training Grant from the Environmental Protection Agency to assist graduate students. This program (M.S. level) is being established in collaboration with the School of Engineering.

Georgia College's Institute of Natural Resources was awarded a \$14,700 NSF grant in the Instructional Scientific Equipment Program to be matched to give \$29,400 to establish a program in aquatic biology. Ten acres of land have been leased from the Georgia Power Company on Lake Sinclair as a field station for this program.

The Department of Biological Sciences, **Eastern Kentucky University**, has been awarded a grant from COSIP (NSF) of \$47,000 and \$34,000 in a U.S. Commercial Fisheries Grant.

The **University of Florida** will establish a Marine Laboratory at Marineland, Florida in the near future (expected completion date: August 1973). The Marineland Corporation has donated five acres of land and Mr. Cornelius Vanderbilt Whitney has contributed \$150,000 towards the cost of construction. The University of Florida Foundation is providing the balance of needed funds. **Dr. Samuel Gurin** will direct the lab for the Division of Biological Sciences and scientists visiting from other institutions will be welcome.

The **Department of Biology, Virginia Polytechnic Institute**, has received three new grants as follows: "Development of acute bioassay technique on fresh-water littoral rotifers," an OWRR grant to **A. Buikema** and **J. Cairns**; "Biodegradation of the toxicity of surfactants to aquatic organisms," a grant from the Soap and Detergent Association to **J. Cairns, A. Hendricks, and K. Dickson**; and an NSF grant to study "Modeling of freshwater and terrestrial antarctic ecosystems" has been granted **B. Parker, R. Hoehn, and R. Paterson**.

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